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(71) Applicant *(for all designated States except US)*: **ZORAN CORPORATION** [US/US]; 1390 Kifer Road, Sunnyvale, CA 94086 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SALMONSEN, Daniel, R.** [US/US]; 710 W. Sunnyoaks Avenue, Campbell, CA 95008 (US). **CERCHIO, Gerald, J.** [US/US]; 875 La Playa, #479, San Francisco, CA 94121 (US).

(74) Agents: **LEHRER, Joel, E.** et al.; Goodwin Procter LLP, Exchange Place, Boston, MA 02109 (US).

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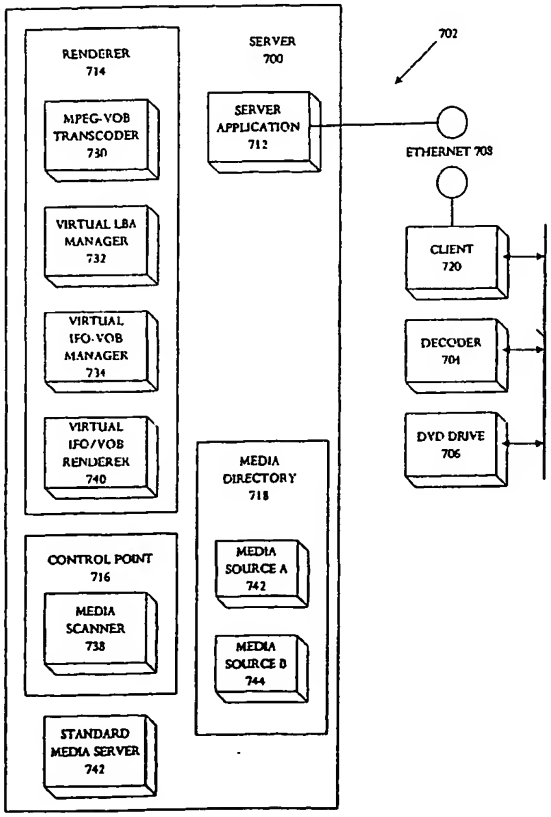

(57) Abstract: A content handling method comprises acquiring content from one or more sources including sources capable of network connection and/or sources capable of local connection. The content and sources are capable of dynamic change. The method further comprises dynamically configuring a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.

WO 2006/019503 A1

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MULTIMEDIA CONTENT MANAGEMENT SYSTEM

BACKGROUND

[0001] In a wide range of applications, devices or appliances exist that perform a single function or only a few functions but have processing, storage and display capabilities that could greatly extend functionality if exploited. Examples of these devices and appliances include televisions, digital video cassette recorders, digital versatile disk players, audio receivers, digital portable entertainment devices, point-of-sale terminals, process controllers and valves, vending machines, alarm systems, home appliances, and many more. Computational power and capabilities of the devices increases as technology evolves and additional software solutions become available, improving user and customer services and experiences with successive product generations. The devices and appliances typically have a dedicated function and unique architecture and, generally, are not designed for interaction with other device or model types, or even with others of the same device.

[0002] Technological advances have created availability of a vast amount of information in many different formats that is accessible by computer networks such as intranets, local area networks, wide area networks, and the internet. The networks allow easy access to information throughout the world and facilitate information delivery world-wide in the form of text files, data, motion pictures, video clips, music files, web pages, flash presentations, shareware, computer programs, command files, and other information. One obstacle to access and delivery of information is lack of interoperability and resource management among devices and content formats. Another problem is an inability to navigate the infinite combinations of sources, content, and formats that are constantly changing and updating.

SUMMARY

[0003] A content handling method comprises acquiring content from one or more sources including sources capable of network connection and/or sources capable of local connection. The content and sources are capable of dynamic change. The method further comprises dynamically configuring a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The features of the described embodiments believed to be novel are specifically set forth in the appended claims. However, embodiments of the invention relating to both structure and method of operation, may best be understood by referring to the following description and accompanying drawings.

FIGURE 1 is a schematic block diagram illustrating an embodiment of a media interface system that facilitates content handling and enables a user device 102 to acquire and perform content acquired from a local server and a remote server.

FIGUREs 2A, 2B, 2C, and **2D** are schematic use case diagrams respectively showing embodiment of a server use case, client and server management use cases, media management use cases, and client use cases.

FIGURE 3 is a detailed state diagram illustrating an example of functions performed by an emulator.

FIGURE 4 is a schematic block diagram depicting an embodiment of a media tree that functions as a network-distributed resource.

FIGURE 5 is a schematic state diagram showing an embodiment of a client media server.

FIGURE 6 is a use case diagram illustrating an embodiment of a media transcoder system including operations between a user device server and a media transcoder.

FIGURE 7 is a component diagram showing various system, hardware, and software components of a server for usage with an emulator interface.

FIGUREs 8A, 8B, and **8E** are timing diagrams respectively illustrating various system interactions.

FIGUREs 8C and **8D** respectively show a schematic use case diagram for server coordination interactions between a primary server and a secondary server, and a state diagram illustrating Server Discover protocol operation.

FIGURE 9 is a schematic sequence diagram illustrating an embodiment of an interaction between a server and a media transcoder.

FIGURE 10 is a sequence diagram depicting interactions of a Simple Object Access Protocol (SOAP) media definition server that supports media tree modification.

FIGURE 11 is a use case diagram showing functionality of an audio-visual system that uses an emulator interface.

FIGUREs 12A and **12B** are a flow chart and sequence diagram respectively illustrating operations of a boot Read-Only Memory.

FIGUREs 13A and **13B** are, respectively, a schematic state diagram depicting an embodiment of drive controller, and a flow chart illustrating an embodiment of drive interface operations.

FIGURE 13C is a schematic flow chart illustrating an embodiment of operations performed by the client to implement UDP protocol communication, enabling rapid packet transmission without TCP overhead.

FIGURE 14A is a schematic block diagram illustrating an embodiment of a media arrangement that can be used by the system.

FIGURE 14B depicts an embodiment of a media directory.

FIGURE 14C is a linked menu diagram showing an embodiment of a Linked Menu Convention (LMC) which enables the application and the client to present to the user a series of menus with a consistent look and feel.

FIGURE 14D is a flow chart illustrating an embodiment of a code segment added to program code for information format (IFO) in cases that TCDR LinkedMenu option is called on a transcoder.

FIGURE 15 is a schematic block diagram showing an embodiment of an eXtended Markup Language (XML) media schema.

FIGURE 16 is a detailed block diagram that depicts functional blocks of an emulation circuit that is suitable for usage in the emulator interface.

DETAILED DESCRIPTION

[0005] What are desired are devices and systems capable of handling widely differing and disparate media devices such as media players and personal computers, and a capability to navigate constantly and dynamically changing content in a high-connectivity system. Multiple multimedia consumer electronic devices and computer systems can be interconnected using wired and/or wireless networks, enabling playback of large format storage -based music, photographs, and video content on AV systems and connected consumer electronic devices. The large format storage and large-capacity hard disk drives can reside, for example, in a Personal Computer (PC) or an entertainment content aggregation system, like a Set Top Box or TWO Personal Video Recorder (PVR). The illustrative system generates a user interface enabling navigation through media made available from remote and/or local sources while the sources and content are dynamically changing and updating as additional sources and content become available. The illustrative system generates such a dynamically changing user interface without changing the look-and-feel of traditional consumer devices.

[0006] In one illustrative embodiment, a DVD player-to-PC connection and an Ethernet IC with no changes to the player's firmware, enables users to view content over a home network without buying specialized hardware. The players can automatically detect the presence of the network and server without interfering with normal playing of a DVD disk. An interface-enabled DVD player enables consumers to easily access all types of Personal Computer (PC)-based audio-visual media content for presentation on home theater equipment without incurring the enormous expense of proprietary, nonstandard electronics, and without struggling to interconnect multiple different systems with disparate interfaces. One example supports widely varying media types including all MPEG, Windows Media, QuickTime, DiVX video formats, JPEG, MP3, WMA, and other still image and music formats, as well as formats not supported by a DVD player.

[0007] The interface and software leverage microprocessor power to supply content to a media device, for example a Digital Versatile Disk (DVD) player connected to a television monitor, in a supported format. The software element in the interface enables communications between the consumer electronic devices and microprocessor media management application software. The illustrative system improves the effectiveness of both the PC as a content-aggregation and media-management tool, and the DVD player as a flexible, feature-rich, easy-to-use playback device. Although details may vary, the PC in the illustrative embodiment can be replaced by a set top box with PVR capabilities, for example, and the DVD player can be replaced by a portable handheld entertainment device, perhaps even a multimedia enabled mobile telephone with a large format Liquid Crystal Display (LCD) screen, for example.

[0008] Referring to **FIGURE 1**, a schematic block diagram illustrates an embodiment of a media interface system **100** that facilitates content handling and enables a user device **102** to acquire and perform content acquired from a local server **104** and a remote server **106.**

[0009] In common operation, when a user device **102** that has yet to be used engages with the media interface system **100**, a process is initiated in which local server **104** and remote sever **106** are searched in an effort to find individual content references as well as content reference "groups". The groups can be in the form of "user preference modules" and/or "user profile" play lists of related entertainment content. The references found are automatically, without user involvement or intervention, aggregated and incorporated into a menuing system of user device **102**. The user can now select, for viewing, listening or both, content related to the aggregated content references. In the case of user preference modules and profiled content, the selection of a particular module or profile enables all the content in the module or profile to be available to the user. The selection of a profile menuing item by the user, for example, could bring up the display of another menu. The new menu can show content selections from the selected profile. In the case that a user device **102** has already been initialized in the described manner, the act of engaging the user device **102** with the media interface system **100** starts an update process which gleans new, different, and/or updated content references from servers **104** and **106** in comparison to the references already

found in the menuing system of user device **102**. The newly acquired references are used to refresh the content references already incorporated in the user device menuing system.

[0010] For significant convenience to the user, the illustrative system supports "user preference modules" and/or "user profiles" that can be easily prepared by commercial ventures and/or other users willing to share lists of content references that are believed to be of interest to the user. Plain text formats as well as significantly more sophisticated public private key encrypted formats, in combination with tools for preparing such lists in appropriate formats, are well known.

[0011] The user device **102** includes a host **108**, generally a controller or processor, which acquires content from one or more sources including remote sources that communicate with the user device **102** via the remote server **106** and a network connection, and local sources via the local server **104**. The content and sources can change dynamically. The host **108** dynamically configures a user interface that enables selection and controls access to content in a user-transparent manner.

[0012] Remote components **106** of the media interface system **100** include a code server **112**, a Digital Rights Management (DRM) server **114**, a media server **116**, and a remote interface server **118**. Local components **120** include a local interface server **104** and the user device **102** and supplies services that are available either locally or remotely. Remote services are contained within network nodes that are not constrained to be within the local segment **120**.

[0013] The code server **112** contains a remote discovery server **124** and remote program code **126**. The code server **112** runs client code such as downloading of program code modules to clients.

[0014] The Digital Rights Management (DRM) server **114** contains a key server **128** and Digital Rights Management (DRM) accounting functions **130**. A memory, such as a boot Read-Only Memory (RAM), can contain encryption keys. For example, code downloaded by a boot ROM may be constrained to be digital signature analysis (DSA)signed. A public key cryptography system enables the boot ROM to contain the public decryption key that prevents the encryption key from being available for any other entity to produce Client software images. Signature bytes can be prepended to the download image, which can be sent as a clear text image. Signing and verification can be performed using OpenSSL (www.openssl.org). In the illustrative embodiment, encryption strength is 1024 bits. The private key is not published.

[0015] The media server **116** contains remote media **140**. The media server **116** supplies media to the clients.

[0016] The remote interface server **118** contains a media server **132**, a remote transcoder system **134**, a Simple Object Access Protocol (SOAP) control block **136**, SOAP media **138**, and a Digital Rights management (DRM) package **142**. The Simple Object Access Protocol is an eXtended Markup Language (XML) that defines use of XML and Hyper-Text Transport Protocol (HTTP) to access services, objects, and servers in a platform-independent manner. The SOAP media definition server **138** communicates

between a media-building application and the server to facilitate application independence. The two applications may reside on the same device or component, or on widely separated components. SOAP ensures industry standard transport of the specific media control information.

[0017] The local interface server **104** contains a local discovery server **144**, a local code server **146**, a local media server **148**, a local transcoder system **150**, local SOAP media **152**, a local SOAP control block **154**, a Universal Plug'N'Play (UPNP) package **156**, a local Digital Rights Management (DRM) package **158** and a diagnostic logger **160**. The various components of the local interface server **104** may all execute within one node or may be distributed across multiple nodes, either on a single network segment or across multiple networks. A Client coder server may operate as an internet remote server enabling client installation into an environment with hardware as simple as a network modem with Dynamic Host Configuration Protocol (DHCP) services.

[0018] The discovery server **144** coordinates other servers and clients. The media server **148** supplies media to the clients. The code server **146** performs application firmware code for usage by clients. The client code server **146** downloads strongly encrypted, signed program code modules to clients. In one example embodiment, the download method can be a variation of Trivial File Transfer Protocol (TFTP) that is modified for efficiency and client recognition.

[0019] Transcoder system **150** converts media and navigation information to client format. SOAP control block **154** enables query operations and setting of server parameters. SOAP media **152** enables query operations and setting of server media. UPNP package **156** integrates the server into the Universal Plug and Play environment. DRM package **158** enables accounting for user payment for play media. Diagnostic logger **160** supplies debugging support for developers. The server supplies a telnet protocol Internet remote computing connection that emits a controllable diagnostic stream as the various components operate. The diagnostic stream and associated controls are viewable using a Server Console application.

[0020] The real-time transcoder system **150** generates menus and converts media in real-time to the media target format. Various functions performed by the transcoder include filtering, estimating filter parameters, initializing filters, creation of menu buttons, getting media packets, getting Information Format (IFO), getting static IFOs, releasing buffers, releasing estimates, setting options.

[0021] In the illustrative embodiment, the user device **102** can contain the host **108** which can also be called a drive emulator, at least one internal media drive **162** which can also be called a drive controller, a network client **164**, a cache memory **166**, a decryption engine **168**, and an internal device diagnostic logger **170**. The user device **102** can operate as a client. In an illustrative embodiment, the host or drive emulator **108** can manage operations relating to an MPEG decoder. The drive emulator **108** enables the system to operate in the manner of a device or component, for example a DVD drive with respect to interactions with an MPEG player. The drive emulator **108** can circumvent operations

in the MPEG-DVD drive connection pathway and enter a pass-through mode of operation, enabling the MPEG player to operate on media within the drive. During the pass-through operating mode, the drive emulator **108** allows the client to monitor all commands sent to the drive and simultaneously intervene. The user device or client **102** has a suitable server interface for communicating with a server. In an illustrative embodiment, a server interface can be through 100 Base T Ethernet. Transmission Control Protocol (TCP) can be used to convey commands to the server and data may be returned either through the same TCP socket of a parallel User Datagram Protocol (UDP) socket. The user device or client **102** also has an appropriate host interface, for example using hardware that emulates an Integrated Drive Electronics (IDE) drive allowing the full AT Applications Program Interface (ATAPI) command set.

[0022] The drive controller **162** is optional and can manage devices such as mass storage devices that are native to the emulator-enabled user device **102**. The network client **164** supplies communication capability to the server. The cache memory **166** intelligently retains and pre-fetches media data. The user device or client **102** has a read-ahead cache **166** for media data and also can have an optional permanent cache for server-specified "sticky" blocks. The decryption component **168** performs real-time decryption of the media. The diagnostic logger **170** is optional and can assist in development of the system. The client **102** supplies a real-time configurable diagnostic stream to a client console. The client **102** can use a diagnostic command shell with an extensive command set, enabling multiple diagnostic tests. Output categories for the data logger **170** include LogError that supplies indication of any error, LogInfo supplying an informational log item, LogDetail supplying detailed state information, LogSystem indicating system-related messages, and LogNet to generate networking messages. Other output categories include LogIDE supplying IDE-generated messages, LogTimer giving timing indications, LogCmd supplying information concerning ATAPI commands, LogHClnt giving network client information, and LogCDB depicting low level CDB messages. LogBCache, LogCmdPrc, BoardIO, and CBDAddr respectively give information concerning bcache activity, command processing activity, board input/output processing, and command and LBA information. MaxDetail, MidDetail, and MinDetail give varying amounts of information.

[0023] Referring to **FIGURE 2A**, a schematic use case diagram depicts an embodiment of a server use case **200** that may be implemented, for example, in servers such as the local media server **148** the remote media server **132** shown in **FIGURE 1**, and the like. Server use cases **200** may be illustrated as two active users - a media monitor **202** and a virtual media driver **204** - arranging the media into a virtual volume **206** so that user devices may access media **208**. The media monitor **202** supplies streaming media from multiple various media content sources. The virtual media driver **204** arranges and stores the media content in a virtual file structure. Use cases in the virtual volume **206**, for example an interface Video Title Set (VTS), pass information between the virtual media driver **204**

and a third user, a Moving Pictures Expert Group (MPEG) decoder **210**. The server **200** also can include a real-time transcoder **212** that transcodes media to communicate between the media monitor **202** and the virtual media driver **204**.

[0024] The media **208** use cases present various content types to the virtual media driver **204** including presenting images and audio content **208A**, presenting multiple movies **208B**, presenting disc images **208C** such as Digital Versatile Disk (DVD) images, presenting a Video Title Set (VTS) **208D**, and presenting multiple audio channels **208E**.

[0025] The interface virtual Video Title Set (VTS) **206** use cases dynamically, in absence of user interaction, control access to information including virtual volume structures **206A** and media extension points **206B** for transcoded media.

[0026] The real-time transcoder **212** has use cases for transcoding media **212A** and estimating **212B**.

[0027] Referring to **FIGURE 2B**, a schematic use case diagram shows an embodiment of client and server management use cases **214**. A stand-alone application called a Console Server can supply user consoles capable of connecting to a server to enable monitoring and configuration of the server. An instance of a server console **216** can be connected to each server on a network.

[0028] A stand-alone application called a Console Client can supply client consoles capable of connecting to an interface client for monitoring and configuring the client. An instance of a client console **218** can be connected to each server on the network. A stand-alone version of a client console can be made available for usage. The command console supports multiple text-based commands for displaying and writing to client registers as well as higher level commands. The console client enables entry of client commands and register values. Client commands include:

Command	Description
Help	Print command list.
Version	Print version number.
Preg	Print register map, #s appear at changed registers.
PowerTest	Perform power-on-reset test.
FirmReset	Perform firmware reset and test.
Dump	Dump memory from designated address range.
Fill	Fill dump memory range with a pattern.
Reg	Read or set byte address in FPGA register space.
LogMask	Print/set the log mask.
MemTest	Test FPGA memory buffer.
<regname>	Print/set register value.
<signame>	Print/set signal value.
IDEaddr	Print/set IDE address master or slave.
GetIDEcmd	Wait for ATAPI command and then print the command.
PushData	Push data for current command in progress.
Wait	Wait for <signame> or <regname> to become a value.
ATAPI	Print ATAPI register set and signals.
Verbose	Activate/deactivate print messages.
TI	Set read wait timing loop.
Rdtoc<session><format>	Read server's TOC, arguments optional.
RunDemo	Start demo task.
StopDemo	Stop demo task.
MyIP	Print client IP address.
Eject	Eject media.
InitBCache <size><gran>	Initialize the BCache using size memory and granularity.
StartBCache<ip><port>	Startup the BCache.
StopBCache	Stop the BCache.
NetSpeed	Test transfer speed to the server.
OpenTray	Open the disc tray.
CloseTray	Close the disc tray.
TUR	Send Test Unit Ready (TUR) to the drive.
MechStat	Get Mech Stat from the drive.
DriveReg	Print drives registers.
PassThrough<on||off>	Set to pass-through mode.
DiscDetect <count>	Set number of TURs to wait for no disk.
WpBit	Return state of wpBit.
SetStream<sector_size>	Set sector size for Digital Stream Interface.
SendStream<#sectors><ssz>	Send stream data.
LoadList lba cnt<lba cnt>	Prepare list of sectors to send.
SendList <lba cnt>	Send loadlist optionally start at lba cnt.
SetIF <avb||ata>	Set bus interface.
sysspeed <server ip>	Test speed while pushing avbus.
MemSpeed	Do SDRAM mem access with different cache settings.
icache <off||on>	Set or report current setting.
dcache <off||on<wt||wb>>	Set or report current setting.
transfer lba cnt	Transfer data starting at lba for cnt blocks.

[0029] Multiple servers, for example a primary server **220** and a secondary server **222** are allocated by primary server election **214A** and coordinated via the Server Discovery Protocol **124, 144** in **FIGURE 1**, and by a send status **214B** use case. A client **224** attaches to a server **214C** and is directed to a server **214D** via use cases. Other use cases include accessing of server lists **214E** and accessing of client lists **214F**.

[0030] The Server Discovery Protocol is used between servers 220, **222** to coordinate the various servers and enable clients **224** and server console windows **216** to locate a suitable server. The primary server **220** is the coder server and the authority for supplying media tree root Internet Protocol (IP) and port numbers to clients. The primary server **220** has three use cases including attach to server **214C**, send status **214B**, and primary server election **214A** use cases. The secondary server **222** has two additional use cases including access client lists **214F** and access server lists **214E** use cases. All clients attach to the primary server **220** which may or may not direct the client to a secondary server **222**. Client and server management use cases **214** govern the interaction of the primary server **220** with the secondary server **222** in sharing client information and in sharing status information. The primary server election **214A** use case includes server cooperation to select the primary. An ad-hoc collection of servers on a network segment cooperate to elect a primary server that coordinates activities of all servers, and to detect and recover from loss of the primary server or any other server. Clients **218** and server **216** console windows are capable of obtaining a list of all servers on the network segment. The interaction protocol efficiently minimizes network usage and disturbances to uninterested node (broadcast traffic). In an illustrative embodiment, evaluation of primary server assignment is limited to the primary server election use case **214A**. No re-evaluation takes place for mere modification of a server's media tree.

[0031] Referring to **FIGURE 2C**, a schematic use diagram illustrates an embodiment of media management use cases **226** that describe interactions of a media designer **228**, a media operator **230**, and a media network operator **232**. The media designer **228** sets an XML media tree **226A** and fetches the XML media tree **226B**. Interactions between the media designer **228** and media operator **230** include locking the XML media tree **226C**, modifying the XML media tree **226D**, and committing the XML media tree **226E**. The media operator **230** accesses Digital Rights Management (DRM) **226F** information, such as keys, accesses server lists **226G**, and accesses client lists **226H**. The media network operator **232** monitors server parametrics **226I** and modifies server parametrics **226J**.

[0032] Referring to **FIGURE 2D**, a schematic use diagram illustrates an embodiment of client use cases **234** that describe interactions of the MPEG decoder **210** and a user device server **336**. A data server operation **234A** is an optional drive-pass-through use case that enables the user device to relinquish control and enable components, for example an MPEG player and a DVD drive, to interact as in any other media player environment. The data server operation **234A** is a local media

augmentation use case that enables the user device server **236** to monitor control information passing between the player and drive. The system may then perform operations affecting both the player and drive and obtaining data from the server **236**. Information on the local media may then be augmented by content available from the server **236**. Local media augmentation uses a media description that is merged from the drive and the server **236**. Client use cases **234** include read **234B**, seek **234C**, media operations **234D**, and drive operations **234E**, that all may pass through the data server operation use case **234A**.

[0033] In some embodiments, the client environment can be implemented in low-level read-only boot firmware and a large read/write memory area for client software execution. The boot read-only memory (ROM) can execute initial network configuration and downloading of client software from a coder server, either remote **112** or local **104** as shown in **FIGURE 1**.

[0034] Referring to **FIGURE 3**, a detailed state diagram illustrates an example of functions performed by an emulator **300**. In various embodiments, the emulator **300** may execute one or more of a plurality of operations from various devices and components such as source devices, sink devices, or external devices.

[0035] In an emulation function, the emulator **300** generates control signals, data, and responses that deceive one or more of the source device, the sink device, and an external device as to the identity of the interacting device. In the sample of an optical media player with a network connection, an optical drive functions as a source, an optical media decoder serves as sink, and a remote computer operates as an external device. The emulator **300** can trick the devices so that the optical media decoder can render content from the remote computer in an interaction identical to an optical drive transaction. The optical drive can source content for the remote computer in an interaction identical to sourcing to the optical media decoder. For a writeable drive, the remote computer can source content for the optical drive in an interaction identical to writing to the drive from a bus.

[0036] Emulator **300** begins operation with a power-up initialization of hardware act **302** that proceeds when hardware tests are successful. Next an initialize operating system kernel act **304** initializes operation software. An initialize TCP/IP stack act **306** prepares an Ethernet stack for communication. A start emulator tasks act **310** commences operation of the emulator **300** including an emulator state machine **312** and a server state machine **314** that execute concurrently and synchronize at *sync points* **315**.

[0037] The illustrative emulator state machine **312** has three wait states including a bus idle with no media **316**, a bus idle with media state **318**, and a bus wait read data state **320**. The illustrative emulator state machine **312** has five command action states including a field drive information request state **322**, a field media request state **324**, a deliver bus read data state **326**, a field read request state

328, and a field seek request state 330.

[0038] The illustrative server state machine 314 has four wait states including a media host connected state 332, a network media idle state 334, a no media host state 336, and a network wait read data state 338. The illustrative server state machine 314 has four action states including a media present state 340, a send seek packet state 342, a send read packet request state 344, and a read data arrives or timeout state 346.

[0039] The no media host state 336 advances to the media host connected state 332 when a media connection is open but returns when the connection is closed. Similarly, the network media idle state 334 returns to the no media host state 336 when a media connection is lost. The media host connected state 332 advances to the action media present state 340 when a media packet arrives but returns when the media is removed. When a media description is available, the emulator state machine 312 advances to the bus idle with media state 318 as the media is identified. The bus idle with media state 318 advances to the field drive information request state 322 upon a drive data request and returns on an acknowledge. The bus idle with media state 318 advances to the field media request state 324 upon a media request and returns on an acknowledge. The bus idle with media state 318 advances to the field read request state 328 on a read request, generating a read logical block address (LBA) signal that places the server state machine 314 in the send read packet request state 344. On a logical block address (LBA) request, the server state machine 314 advances from the send read packet request state 344 to the network wait read data state 338 and returns on a read retry. In the network wait read data state 338, the server state machine 314 advances to the read data arrives or timeout state 346 and, on a queue data signal, places the emulator state machine 312 in the deliver bus read data state 326. On a data transfer complete signal, the emulator state machine 312 enters the bus idle with media state 318 from the deliver bus read data state 326.

[0040] The bus idle no media state 316 of the emulator state machine 312 advances to the field drive information request state 322 upon a drive data request and returns on an acknowledge. The bus idle no media state 316 signals the server state machine 314 when a media descriptor arrives, generating a media ID acknowledge that places the server state machine 314 in the network media idle state 334. The network media idle state 334 in the event of a bus seek request, generates a seek acknowledge that places the emulator state machine 312 in the bus idle with media state 318. The bus idle with media state 318 advances to the field seek request state 330 on a bus seek. The field seek request state 330 upon a seek request generates a seek destination signal that places the server state machine 314 in the send seek packet state 342 which goes to the network media idle state 334 on an acknowledge.

[0041] The network media idle state 334 upon a read request generates a read accepted signal that places the server state machine 314 in the bus wait read data state 320. When data is ready in the bus wait read data state 320, an acknowledge places the server state machine 314 in the network media idle state

334.

[0042] Emulator **300** can determine functionality of a particular sink device and specifically imitate that functionality for a remote device. In a particular example, the emulator **300** can imitate a disk drive by generating one track or stream of MPEG-2 at a constant bit rate or variable bit rate of compressed digital video. The particular emulator **300** may support constant or variable bit rate MPEG-l, CBR and VBR video, at 525/60 (NTSC, 29.97 interlaced frames/sec) and 625/50 (PAL, 25 interlaced frames/sec) with coded frame rates of 24 fps progressive from film, 25 fps interlaced from PALvideo, and 29.97 fps interlaced from NTSC video. Interlaced sequences can contain progressive pictures and macroblocks. The emulator **300** can place flags and signals into the video stream to control display frequency to produce the predetermined display rate. The emulator **300** can control interlacing, progressive frame display, encoding, and mixing. The emulator **300** can display still frames encoded as MPEG-2 I-frames for a selected duration, and can generate a plurality of subpicture streams that overlay video for captions, sub-titles, karaoke, menus, and animation.

[0043] The emulator **300** imitates a device that sources content by exhibiting the file system and methods of communicating with the file system of the source device. During initiation of a source-sink interaction, a system searches for contact on a source device. The emulator **300** mimics the file structure and content search of the source device in a remote device, permitting selection of content from either the actual source device or the remote device emulating the source device.

[0044] In a particular example, the emulator **300** emulates a file system such as a Universal Disk Format (UDF) or micro UDF file system and may support both write-once and rewritable formats. In some examples, the emulator **300** can support a combination of UDF, UDF bridge (ISO 9660), and ISO 13346 standards to ensure compatibility with legacy operating systems, players, and computers.

[0045] If an emulated transaction is selected, the emulator **300** manages the transaction by exchanging requests and data according to the protocols of a source-sink transaction. The emulator **300** also isolates the source device, intercepting and overriding control signals and data communicated by the source device and permitting signals and data interactions between the sink and the remote device as the emulated source. In various systems and transactions, the emulator **300** can imitate a transaction without notification of the sink device. In other systems and transactions, the emulator **300** can convey information to the sink device that indicates that emulation is occurring and identifying the actual remote content source, allowing additional control of network interactions, exploiting any additional capabilities of the remote device, and expanding rendering capabilities. For example, the emulator **300** can control a transaction to allow simultaneous rendering of content from the source device and an emulating remote device. One specific capability is a picture-in-picture display of source content and remote content. Another specific capability is enhanced web-enabled DVD that extends capabilities to combine content from a DVD with special network-accessed applications.

[0046] Software or firmware that is executable by the emulator **300** may include many functions such as media content navigation, user interfacing, servo firmware, and device drivers.

[0047] Referring to **FIGURE 4**, a schematic block diagram illustrates an embodiment of a media tree **400** that functions as a network-distributed resource. A server analyzes media format and sources, and constructs navigation structures that enable a target device to access all distributed media, enabling dynamic control of content access - automatically without user intervention or interaction. Media is accessed as enabled according to digital rights management, encryption, and media play charge considerations. The media tree **400** extends from a root menu **402** that includes pointers to branches including a Video Title Set (VTS) menu **404**, media items **406**, and media menus **408**. VTS menus **404**, media items **406**, and media menus **408** may be accessed via remote media servers **410** and a remote video server **412**.

[0048] Media formats are determined by the transcoder system. For example, most formats that can be displayed by Microsoft DirectShow engine can be transcoded into a DVD MPEG video standard.

[0049] The media system addresses security operations at multiple levels. Media from one media producer is protected against alteration by another media producer. Viewing of media by some classes of users is restricted by another class of user. Viewing of digital rights management media is to be granted by the digital rights owner.

[0050] Referring to **FIGURE 5**, a schematic state diagram depicts an embodiment of a client media server **500** such as the local media server **148** shown in **FIGURE 1**. The dynamic volume states of the client media server **500** include a wait state **502**, a clients idle state **504**, a modify tree state **506**, and a replace tree state **508**. In the wait state **502**, the client media server **500** waits for a SetMediaTree signal or flag. Upon receipt of SetMediaTree, the server builds the media tree **510**, then services client requests **512**. Upon receipt of a modify tree request, the server **500** services the modify tree request **514** and enters the modify tree state **506**.

[0051] In the modify tree state **506** the server services client requests **516**, modifies the tree **518** in accordance with client requests. In a lock-off change tree branch state **520**, a tree branch to be modified is locked-off as non-affected client requests continue.

[0052] Between client requests, the server enters the clients idle state **504**. A tree is replaced only after all clients go onto the idle state **504**. In the modify tree state **508**, the server services client requests **522**, and in accordance with client requests, can destroy an old tree **524** and build a media tree **526**.

[0053] Once the format of a user-supplied media file is determined, for example through examination of the file extension or the file header, other otherwise, the system intelligently assembles a mechanism that performs successful presentation of that file's media on a sink device. The mechanism may be a simple mapping, usage of an extended communication capability, transcoding, or

another technique that supplies content to a sink device and enables the content to play on the device in the device native format without using a hardware or hard-coded translation device.

[0054] In some embodiments, the transcoder or transcoders in a system may be omitted and replaced by one or more decoders that that decode the content into a format compatible for presentation. One decoder implementation may use multiple client-resident decoders. Another decoder implementation uses one or more programmable client-resident decoders that may be reconfigured by downloading multiple versions of client-resident decoder code. Still other implementations may use decoder code downloaded in combination with content in which the decoder code that is appropriate for the particular content and format. Usage of downloadable decoder code enables versatile tailoring of the decoder for specific applications or content format.

[0055] For embodiments that use one or more decoders in place of the transcoders, a decoder interrogates incoming content to determine which decoder is to be used, passes the decoder identification information to the client to enable correct configuration of the decoder. The appropriate decoder generally can perform self-configuration that is transparent to the user, or pass through the appropriate decoder code which accompanies the content and informs the client with a request for the client to self-reconfigure using the supplied decoder code. Decoder implementations are less versatile than the illustrative transcoder systems because the decoder generally entails usage of client firmware and/or hardware that differs from conventional or existing client systems such as DVD players, although future clients may include programmable decoder support.

[0056] Referring to **FIGURE 6**, a use case diagram illustrates an embodiment of a media transcoder system **600** including operations between a user device server **602** and a media transcoder **604**, such as a Digital Versatile Disk (DVD) transcoder. One use case is definition **600A** of a transcoding task in which the interface supplies a list of media files to the media transcoder **604**. The media files are to be transcoded into a specific media Video Object (VOB) or, if appropriate, a series of VOB objects.

[0057] Use case **600B** is a description of the Video Object (VOB). Information is passed from the media transcoding package to the server as a series of media-compliant information format (IFO) file content buffers. The transcoder generates one IFO for each VOB object that is generated. Transcoders generally operate under a presumption that the base address of the VOB file series is logical block address (LBA) 0 and the server manages logical block address transformations appropriate for presentation to the decoder.

[0058] A raw media file data fetching use case **600C** fetches data for transcoding. The server supplies a conventional read-only block-oriented interface for the transcoder to fetch raw media data using random access handling.

[0059] A provide transcoded data use case **600D** supplies a VOB data stream in real-time for the

server to convey to the decoder in synchrony with data fetching. A transcoder management use case **600E** supplies common resource management for the media transcoder **604** and the server **602**. Transcoders are created and used in real-time on an as-needed basis. When a particular transcoding operation is complete, the transcoder is terminated and removed.

[0060] Referring to **FIGURE 7**, a component diagram shows various system, hardware, and software components of a server **700** for usage with an emulator interface. The illustrative server **700** is capable of executing on a system **702** such as a computer, a personal computer, workstation, laptop, palm held computer, notebook computer, or any other type of device for executing programmed code. The server **700** can communicate with one or more various information handling devices, including devices that function as a source or information or content, devices that display, perform, or render the sourced information or content, and control devices. In the illustrative example, the server **700** is configured to communicate with a client device **720**, a decoder **704** such as an MPEG decoder, and a DVD drive **706** via an Ethernet connection **708**. These devices are for illustration only and can be supplemented or replaced by many other types of information handling devices. The client device **720**, the decoder **704**, and the DVD drive **706** are each shown in a single system coupled by an IDE bus **710**. In other examples, the devices may be configured in different systems and may have internal interfaces different than the IDE bus **710**.

[0061] The server **700** includes one or more server applications **712** that execute in conjunction with an audio-visual (AV) system **715** and a media directory **718** to manage interactions among a variety of audio-visual devices and controllers. The server **700** communicates with the devices over the Ethernet connection **708** by operation of a server application **712**, for example a software application that executes a desired content handling application. A server application **712** virtualizes media into a volume of data that is navigable by the system **715**. The server application **712** can assess characteristics of source media and, if needed, modify characteristics into a more familiar form. For example, a DVD-based server **700** may change data format to appear more as a DVD disc. The server application **712** manages data streaming to one or more of multiple clients that may be connected to the server **700**.

[0062] Generally, the server application **712** controls the information transfer entities and the type of processing. The server application **712** determines and selects devices that function as the content source and renderer, the type of processing performed on the content, and any control and management functionality. For example, the server application **712** can initially generate a graphical user interface display indicative of the types of content available for performance and classes of processes that can be performed on the content. A user can respond to the display by selecting the desired content and processing. The server application **712** can generate and send control signals to the selected content source and renderer that commence content accessing, transmission, rendering, and display. The server

application 712 can generate and send control signals that activate devices, if any, in the path from source to renderer that process or modify the content. In some applications, the server application 712 can execute content processing routines that are suitably executed on the server processor.

[0063] The AV system 715 defines and manages general interactions among various types of audio-visual devices and supports a broad range of device configurations and applications independently of device type, content format, and data transfer protocols. For example, the AV system 715 can support an open-ended variety of audio-visual devices including, but not limited to, computers, PCs, laptops, palm-held computers, cellular telephones, workstations, video displays, electronic picture frames, televisions, CD/DVD players and jukeboxes, video cassette recorders, set-top boxes, camcorders, still-image cameras, audio systems, stereos, MP3 players. The AV system 715 can support an open-ended broad variety of content, information, and data formats including, but not limited to, Motion Pictures Expert Group (MPEG2, MPEG4), Joint Photographic Experts Group (JPEG), audio standards including MPEG-1 Audio Layer-3 (MP3), Windows Media Architecture (WMA), bitmaps (BMP), National Television Standards Committee (NTSC), Phase Alteration Line (PAL), Sequential Couleur avec Memoire (SECAM), Advanced Television Systems Committee (ATSC), video compact disk (VCD) and S-VCD standards. The AV system 715 selects and defines functionality of various content sources, content renderers, and controllers in combination with a server application 712 and the media directory 718.

[0064] The AV system 715 comprises a media renderer 714, a media controller 716, and a standard media server 742. The AV system 715 defines and manages interactions among a content source, a content renderer, and an AV interaction controller. In some embodiments, the AV system 715 can be highly flexible and compatible with any type of media source device and any type of media rendering device.

[0065] The server 700 accesses content from one or more media sources 744 and 746 from the media directory 718. The media controller 716 enables a user to locate and select content from the media directory 718 and to select a target renderer. The media renderer 714 obtains the selected content and directs transfer of the content to the selected target renderer.

[0066] In the illustrative example, the media renderer 714 includes a transcoder 730, a virtual logical block address (LBA) manager 732, a virtual content file manager 734, and a virtual content renderer 740. In one embodiment, the transcoder 730 is an MPEG to video object block (VOB) transcoder and the virtual content file manager 734 is a virtual IFO/VOB manager. The MPEG-VOB transcoder converts from an MPEG format that is commonly used to compress and display video content for computer handling to VOB files that are the standard format of DVD presentations and movies. VOB files contain multiple multiplexed audio/visual streams. The virtual IFO/VOB manager handles VOB files and information format (IFO) files containing

information that describes the particular format of VOB files including playing information such as aspect ratio, subtitles, menus, languages, and the like.

[0067] The server **700** can include transcoders and virtual content file managers that transcode information in other formats depending on the particular audio-visual application. For example, a transcoder **730** can be implemented that transcodes content to and from various formats including one or more of MPEG video, Digital Video (DV), MPEG elementary (ES) or program streams (VOB), YUV4MPEG streams, NuppelVideo file format and raw or compressed (pass-through) video frames and export modules for writing DivX, OpenDivX, DivX 4.xx or uncompressed AVI files with MPEG, AC3 (pass-through) and PCM audio. One example of a particularly useful transcoding application is transcoding of JPEG to MPEG. In another example, digital video can be transcoded to MPEG including transcoding of low quality digital video to high quality MPEG.

[00681 In an audio example, the transcoder **730** can transcode an MP3 media file to a Dolby AC3 pulse-coded modulation (PCM) format.

[0069] In a DVD player application, the transcoder **730** can transcode any transcribable media for viewing on a DVD player. For example, a power-point presentation can be transcoded to a video presentation on a DVD player.

[0070] The transcoder **730** executes decoding and encoding operations using content loading modules including import modules that feed transcode with raw video/audio streams and export modules that encode data frames. A typical transcoder **730** supports elementary video and audio frame transformations, including video frame de-interlacing or fast resizing and external filter loading. Various operations performed by the transcoder 730 include demultiplexing, extracting, and decoding of source content into raw video/audio streams for import, and probing and scanning of source content to enable post-processing of files, setting file header information, merging multiple files or splitting files for storage.

[0071] In a typical transaction, the transcoder **730** is activated by a user command and initializes content transfer, activating modules that begin transfer and buffering of audio and video streams and encoding frames. For example can initiate transfers by creating a navigation log file that contains the frame and related group of picture list with file offsets. The transcoder 730 then executes one or more video/audio frame manipulations or simply passes through raw frame data without manipulation. Video frame manipulations may include removing an arbitrary frame region for processing, de-interlacing a video frame, enlarging or reduction of video width or height, filtering for image resizing, removing an arbitrary frame region for encoding, and downsampling of video widtb/height. Other video manipulations may include video frame flipping or mirror imaging, gamma correction, anti-aliasing, or color manipulations. Audio frame manipulations may include volume changes, audio stream resampling, and synchronizing video and audio frames.

[0072] The transcoder 730 can load export modules for audio/video encoding and begin an encoder loop operation that started for the selected frames.

[0073] The virtual LBA manager 732 controls definition and accessing of virtual logical block addresses in the media and relates the virtual logical block addresses to physical storage addresses of the media. By creating virtual logical block addressing, the virtual LBA manager 732 manages dynamic access of content from a variety of different content sources in the manner of a particular physical source. In this manner, the virtual LBA manager 732 enables a first device, for example a nonstandard or nontypical device, to emulate a second device, for example a device that normally supplies content within a system, using logical block addressing. In a particular example, the virtual LBA manager 732 can emulate addressing of DVD player content from content acquired from the Internet.

[0074] The virtual content manager 734 operates in conjunction with the virtual LBA manager 732 to dictate a map of physical addresses to virtual block addresses. The virtual content manager 734 tracks all elements of content data and maintains links among associated data including local data links and remote data links. Storage on the server 700 is in the configuration of multiple linked lists among files that reference one another. The virtual content manager 734 maintains links among files, identifying and positioning on one or more media volumes. The virtual content manager 734 verifies and ensures that the IFO file references are maintained to assure consistency of references at a directory and volume management level.

[0075] The virtual content manager 734 functions to handle storage and accessing of media content in the manner that a virtual memory manager operates in a computer. A virtual memory manager tracks chunks of memory. The virtual content manager 734 tracks chunks of media. The virtual content manager 734 enables multiple chunks of media to be stored with overlapping addressing.

[0076] The virtual content manager 734 receives commands from the media controller 716 that initiate or modify accessing and presentation of content. The virtual content manager 734 responds by determining the format of IFO and VOB files and activating the virtual LBA manager 732 and transcoder 730, if needed, to begin media streaming. The virtual content manager 734 also functions in conjunction with the virtual content renderer 740 to perform media rendering.

[0077] The virtual content renderer 740 operates on media files to format media to meet the functionality and capabilities of a presentation device, such as a DVD player.

[0078] In an illustrative embodiment, the virtual content renderer 740 is a virtual IFO/VOB renderer. The virtual content renderer 740 manipulates content data according to directions by the virtual content manager 734 to render content. The virtual content renderer 740 manipulates content data elements, supplying information to files identified and located by the virtual content manager 734. The virtual content renderer 740 also creates IFO files for media that do not already have IFO files including creation

of selection trees that appear as cascading menus. IFO files are used to play various files including presentation of menus. Menus are a selection presentation for clusters of media. The virtual media renderer **740** can generate multiple menus in a tree structure until all media is accessible. The virtual content renderer **740** creates IFO files as a manifestation of a play list structure.

[0079] Other examples of media that do not have IFO files are MPEG from digital video or other a myriad of other sources such as power point data for slide shows. In some applications, the virtual content renderer **740** adds content that would not exist without rendering for presentation. For example, the virtual content renderer **740** can configure JPEG images and add filling content to create a slide show of MPEG images to generate slide-show functionality. The illustrative media controller **716** includes a media scanner **738**. In an illustrative embodiment, the media controller **716** allows monitoring of how the media is evolving through operation of the media scanner **738**.

[0080] The media scanner **738** tracks the media directory **718**, enabling media content and the media directory **718** to be mutable. The media scanner **738** regularly accesses the media directory **718** to determine whether any changes in the content of the media directory **718** have occurred and changing virtual structures in the media renderer **714** and the server application **712** to track changes in the media. The media scanner **738** monitors for changes and responds to any changes by updating virtual structures.

[0081] The standard media server **742** can access a variety of content, either locally stored or stored on an external device. The standard media server **742** is capable of accessing content and transferring the accessed content to another device via a network using a standard transfer protocol, for example HTTP or FTP. The standard media server **742** can locate content available on a network from a variety of devices and communicates with the media controller **716** to enable browsing or searching for available content items. The standard media server **742** typically includes a content directory, a connection manager, and a transporter. The content directory includes functions that interact with the media controller **716** to search or browse for content, supplying information and properties that specifically identify the content. The connection manager manages connections associated with a particular device including preparation for content transfer, issue of flow control commands, distinguishing of multiple instances to support multiple renderers, and terminating connections when a transfer is complete. The transporter can be used to operate in conjunction with the media controller **716** to control content flow. The standard media server **742** can supply media that does not require large changes for accessibility by conventional rendering hardware.

[0082] The media directory **718** is a media container, holding a list of all available media content and possibly some or all of the media content. The media directory **718** operates as a virtual media directory, enabling and facilitating access to locally-stored media content and remote media contained by other servers and devices. The media directory **718** stores Uniform Resource Identifiers (URIs) that

identify content resources. URIs includes WWW addresses, Universal Document Identifiers, Universal Resource Identifiers, and combinations of Uniform Resource Locators (URL) and Names (URN). Uniform Resource Identifiers are formatted strings that identify a resource by name, location, or another characteristic. The media directory **718** holds URIs of all files that the server **700** can deliver for rendering. The URIs can correspond to files stored anywhere.

[0083] The media directory **718** identifies available content sources, for example media sources **744** and **746**, and contains directory information to facilitate acquisition of content from one or more of the media sources.

[0084] Referring to **FIGURE 8A**, a timing diagram illustrates interactions **800** between the renderer **714** and server application **712** via a communication thread **802**. In the illustrative embodiment, a dynamic link library (DLL) MaestroLink Netcoms communication calls a process:

bool MaestoLinkRegister(void);

A Noop returns true when a connection is made and ready to begin requesting:

bool MaestroLinkComm(unsigned int *lba, unsigned int *count, *unsigned char *data, unsigned int count).

[0085] The call supplies data to MaestroLink and collects the next request in one operation. For the first call to MaestroLink, the dlength is zero and the data pointer is NULL. MaestroLink supplies the request at the designated pointers. Once the data is available, MaestroLinkComm is called again and the data now is valid. A return is not made until MaestroLinkComm has obtained the next dat request. To enable cross-checking, the logical block address and count are only changed by the MaestroLinkComms download link library.

[0086] Referring to **FIGURE 8B**, a timing diagram illustrates interactions **804** between a user device **806**, a Dynamic Host Configuration Protocol (DHCP) server **808**, a server application **810**, and a discovery server **812**.

[0087] **FIGURE 8C** is a schematic use case diagram **814** for server coordination interactions between a primary server **816** and a secondary server **818**. The Server Discovery protocol enables coordination and orderly operation of the servers on a network segment. A network segment contains one or more servers and zero or more clients and/or Server Console Windows. A paradigm of the primary server **816** and zero or more secondary servers **818** enables a single entry point for clients requesting media trees. The Server Logging Console supplies a window-based user interface for controlling and monitoring any server on the network. The Console Server enables access to server and client Internet Protocol (IP) addresses, for example the IP address and

possibly machine names of the server running on a local device can be shown in a Title Bar, and a list of server and client IP addresses and associated machine names can be maintained by the server and displayed in the Server Console Window. Server functions are available for modification in the Server Console Window via a Tools menu. Logging configuration can be displayed and controlled by a logging control checkbox. Log history size, logging of internal errors and actions, and other functions can be accessed via an Options menu.

[0088] The state diagram depicted in **FIGURE 8D** illustrates the Server Discover protocol in operation. The Server Discovery protocol enables orderly operation of multiple servers on a network segment. A network segment contains one or more servers and zero or more clients and/or Server Console Windows. The primary server and zero or more secondary servers create a single entry point for clients requesting media trees. Multiple distinct states are defined as part of the protocol. The protocol defines the states, operation in the states, and packets specific to each state. The defined states are Discovery **820**, Operational **822** and **824**, and Arbitration **826**. In an illustrative embodiment, the protocol uses ZMP_ServerDiscovery operation codes and enables usage of ZMP_Request, ZMP_Reply, ZMP_Status, ZMP StatusRequest, ZMP_StatusREply, ZMP_Arbitrate, and ZMP_Beacon sub-codes.

[0089] In a Discovery state **820**, a server attempts to locate the current Primary Server on the network segment. The server locates the current Primary Server on the network segment by broadcasting a ZMP_ServerDiscovery/ZMP_Request. If a ZMP_ServerDiscovery/ZMP_Reply response is received, that Primary Server IP address is retained for future use and the server transitions to Operational Secondary State **822**. If no Primary Server response is received after a number of attempts to locate a Primary Server before transitioning fro Discovery State **820** to Arbitration state **826** called SERVER_DISCOVERY_SERVER_LOCATE_MAX_TRYS attempts spaced by a set time to wait for a response to an individual ZMP_ServerDiscovery/ZMP_Request called a SERVER_DISCOVERY_SERVER_TIMEOUT_MILLISECONDS time, Arbitration state **826** is entered. The current Primary Server is to respond with a ZMP_ServerDiscovery/ZMP_Reply packet with the list of servers as a payload. A Server Console Window may also broadcast a ZMP_ServerDiscovery/ZMP_Request to enable location of the Primary Server and receive a list of all servers. The ServerConsoleWindow can use a back-off retry policy.

[0090] In the operational states, the Primary Server maintains a list of Secondary Servers and supplies the list via a ZMP ServerDiscovery/ZMP_Beacon and ZMP_ServeDiscovery/ZMP_Reply packets. A unicast reply packet is sent in response to a ZMP_ServerDiscovery/ZMP_Request, while a broadcast beacon is sent at a time between ZMP_ServerDiscovery/ZMP_Beacon packets sent by the Primary Server called SERVER_DISCOVERY_BEACON_PERIOD_MILLISECONDS time intervals. The Secondary Servers are responsible for monitoring the Primary Server and re-arbitrating if the Primary Server is declared absent. A Secondary Server also informs the Primary Server of the

monitored status. All servers watch for arbitration packets. If a server receives an arbitration packet, the receiving server transitions to the Arbitration state **826**. In an Operational Primary State **822**, a list of servers is maintained by the Primary Server by noting which servers have sent ZMP_ServerDiscovery/ZMP_Status packets recently. A particular server that has issued no packets in SERVER_DISCOVERY_SECONDARY_MISSING_MILLISECONDS is removed from the server list. A list of servers is supplied by the Primary Server via usage of a ZMP_ServerDiscovery/ZMP_Beacon packet sent every SERVER_DISCOVERY_BEACON_PERIOD_MILLISECONDS. The beacon packet contains the list of servers. In an Operational Secondary State **824**, a Secondary Server maintains information in the Primary Server of status for inclusion of the Secondary Server in the Primary Server's list of servers. The Secondary Server maintains status by sending regular unsolicited ZMP_ServerDiscovery/ZMP_Status unicase packets to the Primary Server. If the Secondary Server does not receive a ZMP_ServerDiscovery/ZMP_Beacon packet from the Primary Server within SERVER_DISCOVERY_PRIMARY_MISSING_MILLISECONDS, then the Secondary Server transitions to the Arbitrate state **826**. If a Secondary Server receives a ZMP_Discovery/AMP_Arbitrate packet, the Secondary Server transitions to the Arbitrate state **826** unless the Server's priority is lower than the received arbitration packet.

[0091] A Server Console Window may use either the broadcast of unicast version of ZMP_ServerDiscovery/ZMP_Request to obtain a list of servers from the Primary Server. If the Primary Server is known, typically the unicast version is used in preference to the multicast broadcast. If the Primary Server is not located via unicast, the Server Console Window enters fallback to broadcast requests in case the saved Primary Server IP address is state.

[0092] The Arbitration State **826** votes for the Primary Server. The Arbitration State **826** is entered when no Primary Server is detected by any Secondary Server on the network segment or when any server has received a ZMP_ServerDiscovery/ZMP_Arbitrate packet. In the Arbitrate state **826**, all servers commence sending broadcast ZMP_ServerDiscovery/ZMP_Arbitrate packets if the servers remain contenders for the server list. If a received arbitration packet indicates that a particular secondary server in Operational Secondary state would lose arbitration, then the server is maintained in the Operational Secondary state. All servers except the current Primary Server waits a small random-length delay from detection of the first arbitration packet before sending a responding first arbitration packet, thereby limiting collisions by network responders. A "last one standing" algorithm is used to determine an arbitration winner. Each time a server receives a ZMP_ServerDiscovery/ZMP_Arbitrate packet, the receiving server continues to compete for Primary Server status. Possible rules and priorities are: a command-line configured as Primary wins, shortest tree wins, and lowest MAC address wins. A server that is not informed that another server has highest priority continues to send arbitration packets, otherwise the

server transitions to Operational Secondary state **822**. The server resumes sending ZMP_ServerDiscovery/ZMP_Status packets upon receipt of a ZMP_ServerDiscovery/ZMP_Beacon packet. If the server does not receive a packet from the Primary Server within SERVER_DISCOVERY_PRIMARY_MISSING_MILLISECONDS, the Secondary Server transitions to the Arbitration State **826**. The winner detects success by noting that SERVER_DISCOVERY_ARBITRATE_MAX_TRYS uncontested ZMP_ServerDiscovery/ZMP_Arbitrate packets spaced by SERVER_DISCOVERY_ARBITRATE_PERIOD_MILLISECONDS have been sent by the winner. The winner announces success by transitioning to the Operational Primary State **824** and sending a ZMP_ServerDiscovery/ZMP_Beacon packet.

[0093] Server Discovery Protocol defines the content of network packets and the context of usage. Some packets including ZMP_ServerDiscovery/ZMP_StatusRequest and ZMP_ServerDiscovery/ZMP_StatusReply describe individual server status, carrying a payload of ZMPDiscoverServerStatus. The destination of the packet is set byZMP_ServerDiscovery/ZMP_StatustoPrimaryServer and ZMP_ServerDiscovery/ZMP_Status ReplytoRequestor. Every SERVER_DISCOVERY_STATUS_PERIOD_MILLISECONDS, each Secondary Serer sends unsolicited unicast ZMP_ServerDiscovery/ZMP_Status packets to the Primary Server. The packets are collected and organized into a list of servers and clients by the Primary Server. Every server, either primary or secondary, responds to a ZMP_ServerDiscovery/ ZMP_StatusRequest with a ZMP_ServerDiscovery/ZMP_StatusReply. The payload includes a ZMPDiscoverServerStatus object containing the server's IP, Flags (currently zero), load factor (100 x LoadFactor / MaxLoadFactor = percentage load), a count of clients and a list of zero or more client IP addresses.

```
typedef struct ZMPDiscoveryServerStatus_s {
  Unsigned int ServerIP;
  unsigned short Flags;
  unsigned short MaxLoadFactor;
  unsigned short LoadFactor; unsigned
  short Clients; Unsigned int ClientIP[ ]
} ZMPDiscoveryServerStatus;
```

[0094] Server status is requested by issuing a ZMP_ServerDiscovery/ ZMP_StatusRequest packet to a destination that is either the Primary Server or a Secondary Server. The packet is issued to elicit individual server status. A Primary or Secondary Server will respond to ZMP_ServerDiscovery/ZMP_StatusRequest with a ZMP_ServerDiscovery/ZMP_StatusReply.

[0095] Server discovery is requested using a ZMP_ServerDiscovery/ZMP_Request packet directed to a destination such as a broadcast MAC and IP or unicast if the Primary Server is known.

A new Secondary Server or Server Console Window, when coming on line, begins broadcasting requests to locate the Primary Server. A Server Console Window repeatedly sends the request until the reply is received. A Secondary Server ceases sending requests upon receiving the reply or by beginning arbitration. When operating as a Secondary Server, if no response is received from the Primary Server after SERVER_DISCOVERY_SERVER_LOCATE_MAX_TRYS attempts to send ZMP_ServerDiscovery/ZMP_Request and waiting SERVER_DISCOVERY_SERVER_ TIMEOUT_MILLISECONDS, the Secondary Server presumes no Primary Server exists and enters the Arbitration state **826**. If sending unicast, after the first unanswered request, remaining requests are broadcast.

[0096] The Primary Server sends a beacon as broadcast MAC or IP using a ZMP_ServerDiscovery/ ZMP_Beacon packet with a ZMPDiscoveryServerBeach payload that specifies a servers list. The Primary Server sends the broadcast beacon every SERVER_DISCOVERY_BEACON_PERIOD_MILLISECONDS to prevent SecondaryServers from arbitrating. The ZMP_ServerDiscovery/ZMP_Beacon payload includes the Server's IP, a Flags word that is currently zero, and a count of Secondary Servers and zero or more Secondary Server IPs. The payload can have the following format:

```
typedef struct ZMPDiscoveryServerBeacon_s {
  Unsigned int ServerIP;
  unsigned short Flags;
  unsigned short SecondaryServers;
  Unsigned int SecondaryServerIP[ ];
} ZMPDiscoveryServerBeacon;
```

[0097] The reply from the Primary Server beacon is in the form of a ZMP_ServerDiscovery/ZMP_Reply packet with a ZMPDiscoveryServerAggregateStatus payload. The destination is a reply to specific MAC and IP addresses. The reply is returned unicast to the requestor in response to the ZMP_ServerDiscovery/ZMP_Request, a request that can be unicast or broadcast. The ZMPDiscoveryServerAggregateStatus payload includes a Server IP, 16-bit Flags word that is currently zero, and a count followed by one ore more ZMPDiscoveryServerStatus structures. The first structure is used for the Primary Server. The payload can have a form as follows:

```
typedef struct ZMPDiscoveryServerAggregateStatus_s {
  Unsigned int ServerIP;
  unsigned short Flags;
  unsigned short Servers;
  ZMPDiscoveryServerStatus; Status[ ];
} ZMPDiscoveryServerAggregateStatus;
```

[0098] To arbitrate for status as Primary Server, a contender sends ZMP_ServerDiscovery/ZMP_Arbitrate packets to a destination via broadcast MAC and IP with a payload including MediaTreeLength and CommandLineConfiguration. To win arbitration, a contender is to win SERVER_DISCOVERY_ARBITRATE_COUNT uncontested arbitration cycles. Each cycle includes broadcasting of a ZMP_ServerDiscovery/ZMP_Arbitrate packet followed by SERVER_DISCOVERY_ ARBITRATE_PERIOD_MILLISECONDS collection period to monitor and evaluate responses. If the contender's arbitration priority is less than that of a response, the contender transitions to Operational Secondary State **822**. After winning arbitration, a server transitions to Operational Primary State **824** and begins sending ZMP_ServerDiscovery/ZMP_Beacon packets, indicating winning of the arbitration. An example of the ZMP_ServerDiscovery/ZMP_Arbitrate packet follows:

```
typedef struct ZMPDiscoveryServerArbitrate_s {
  Unsigned int ServerIP;
  unsigned short Flags;
  unsigned short ArbitrationCount; Unsigned int
  MediaTreeLength;
  Unsigned int CommandLineConfiguration;
} ZMPDiscoveryServerArbitrate;
```

[0099] Referring to **FIGURE 8E**, a timing diagram illustrates a media server **830** in interactions between a MediaMonitor **832**, a VirtualBlocker **834**, and a ClientSocket **836**. Media Attach supplies a list of all files in the volume. In a first pass, the file list is restricted to be a copy of an existing TS-VIDEO directory. All files are already mutually coherent during the first pass. The Media List contains an array of structures, each structure describing the name and length in bytes of the file in the media directory. LBArequest (2) makes a volume data request that results in a returned dataBlock (3). LBArequest (4) makes an IFO File Request, that is executed by Open (5), MediaRead (6), retumEntireFile (7), and Close (8). LBArequest (13) makes a VOB File Request, that is executed by Open (14), MediaRead (15), returnDataBlock (16), and return MediaConnection (17). VOB DataClose occurs when the MediaConnection no longer has data to communicate. If data is encrypted, the media reader supplies the key via Request crypt key (20) and return key (21).

[0100] Referring to **FIGURE 9**, a schematic sequence diagram illustrates an embodiment of an interaction between a server and a media transcoder. Transcoders are transient objects that perform a designated function when requested and either go dormant using a minimum amount of system resource or are completely destroyed at the end of the task. All calls to the transcoder may be performed concurrently so that the transcoder is responsible for multiple-thread protection of critical code areas. A transcoder may be deleted while in any state to carefully attend to resource release at deletion.

[0101] In an illustrative embodiment, a transcoder is referenced by a single immutable integer entity by the interface system. The entity is a unique token that is passed to the interface routines to distinguish multiple created transcoders from one another.

[0102] The transcoder has two distinct functions. A first function is to survey a task and produce a parametric on the resulting MPEG object. A second function is to perform transcoding of the given media objects into an MPEG data stream. All object input/output operations for the tasks are performed through the input/output system.

[0103] Upon creation, a transcoder receives a list of User Identifiers (UIDs) that may be any mix of media objects. The transcoder also receives an enumerated value designating a requested target format, for example an MPEG format. The transcoder library can recognize and transcode media objects, for example including single frames, audio, audio in combination with a single frame, and video objects. A single frame is any series of static graphic objects to be converted to a target format such as into an MPEG slide show. The transcoder performs bitmap size, pixel size, and color depth conversion for an optimum display of a given object. Audio data is any series of audio objects to be converted into an MPEG audio file with a single default video slide presented throughout the media experience. Chapter stops are set on every object border. Audio and single frame data are presented to the transcoder as an audio object followed by a series of single frame objects. The transcoder produces an MPEG stream in which the single frame objects transition evenly through the audio object play time. Chapter stops are set on the audio object transition points. The transcoder produces a best fit target stream, such as the MPEG stream, for presented Video objects. In the case of a video frame that is too small to be converted to a minimum MPEG resolution, transcoded data may include black bordered in the stream with mild zoom. The specific media source objects and formats are iterated in the deliverable time table. The time table also dictates the MPEG formats time of delivery.

[0104] Upon creation, the transcoder users interface-supplied input/output routines to survey a file list. The transcoder produces an IFO file structure that the system uses to construct a media delivery system. The IFO file descriptor of the resulting media data stream may be slightly larger than the actual resulting stream with the extra size included at the end of the entire stream. Even if the resulting stream creates multiple 1 gigabyte VOB segments, all IFO specified excess space is appended to the logical end of the stream. Most of the IFO includes non-essential content including boilerplate, stream descriptors, and the like, however a play list enables proper functioning of the system. The transcoder IFO structure data includes a first transcoded VOB object that begins at logical address 0 and each subsequent VOB is contained in the same contiguous logical address space. The transcoder estimates the size of the media stream in some cases and the estimate is always larger than the actual size but within 10% of the overall actual size.

[0105] In an illustrative embodiment, IFO file structures supplied in a transcoder survey

include VTSI_MAT, PTT_PRTI, VTS_PGCITI, VTSM_PGCI_UT, VTS_TMAPTI, VTSM_C_ADT, VTSM_VOBU_ADMAP, VTS_C_ADT, and VTS_VOBU ADMAP. VTSI_MAT is the main-IFO table and is essentially included in each IFO file. VTSI_MAT table specifies the contained video and audio streams in the VOB file. The video stream can be specified as compressed video such as MPEG1 or MPEG2, television video such as (National Television System Committee) NTSC or Phase Alternation Line (PAL). Other values in VTSI_MAT table specify aspect ratio, display mode such as letterboxed, bit rate (Variable (VBR) or constant (CBR)), and resolution.

[0106] PTT_PRTI is a chapter table that is essential if the content contains a movie. A chapter table, if included, specifies at least one chapter and contains a chapter number 1. A chapter specified by PTT_PRTI links to a program in a PGC in the table.

[0107] VTS_PGCITI is a main program chain that handles media playback. The Program Group Control (PGC) has at least one program, which links to the first cell in the PGC. Accordingly, at least one cell is contained in the PGC and holds the start sector in the VOB file of the cell, the playback time, and the end sector of the cell.

[0108] Video title set file structures including VTSM_PGCI_UT, VTS_TMAPTI, VTSM_C_ADT, and VTSM_VOBU_ADMAP are nonessential structures. VTS_C_ADT holds a list of all cells within the VOB file. Cell values contain start and end sector addresses within the VOB file. VTS_VOBU_ADMAP is a table that holds a list of all VOB units inside the VOB file, and contains the start sector of each VOB unit inside the VOB file.

[0109] Once the survey function is completed, the transcoder enters a dormant state until the interface executes a GET function to draw some of the media stream, for example an MPEG stream, from the transcoder. The media stream fetches are random-access at an address based upon an initial zero address of the VOB object. Every fetch has a starting logical block address (LBA) which is offset into the media stream of 2048 data blocks.

[0110] Once a GET request is made by the transcoder, the transcoder uses either the user device-supplied input/output interface or a media graph functionality (for example From Microsoft Corporation of Redmond, Washington) to fetch the appropriate media data. The input/output routines are asynchronous and do not return unless the input/output operation is complete or an error condition occurs. The transcoder then transcodes the received portion into a transcoder-managed input/output buffer. The number of 2048 byte blocks transcoded by a single GET call are determined by the transcoder and affected by the constructed media graph and the domain within which the graph operates. The domain may be defined in terms of time or number of bytes transcoded. The stream is restricted to any number of 2048 byte blocks within a predetermined maximum. In an illustrative embodiment, the capacity is set to 512 kilobytes. The GET routine enables the transcoder to set the number of 2048

byte blocks that are returned in the buffer.

[0111] The buffer is passed as immutable to the user device for stream delivery. The user device later performs a separate call to the transcoder to release the buffer back into the transcoder's buffer pool. The user device may register multiple GETs from multiple threads on the transcoder. The multiple GETs may not be serialized because the logical block addresses may not be requested in order of delivery. Suspends may occur only during the input/output operation.

[0112] The user device views the function of transcoding as an inherently stateless process. A specific piece of the media stream is requested and that portion is returned. A next request does not necessarily relate to any other request. The transcoder accordingly simply remains idle awaiting a stream request. If the transcoder is deleted during any request or set of requests, the transcoder retrieves all active GETs with an error indication, waits for outstanding input/output, and then organizes resources.

[0113] The sequence diagram in **FIGURE 9** shows the server-transcoder iteration. Beginning at an interaction **901**, an estimation process is documented in which a transcoder is constructed to supply an information hallway with a TCDR_info structure to hasten future instantiations of the transcoder with the same media file. Interactions **906** through **908** may repeat many times. Many files may be open and remain open during the transcoder lifetime. In one embodiment, Microsoft transcoder graphs may be used to directly access local files. The illustrative example demonstrates a set of transcoder interactions using a set EndOfMediaVOB option. The option is set before the first GET is called. Interactions **912** through **914** repeat until the media is exhausted. At the end of media no buffer is returned and an end-of-media return is made. A user thread then may continue to fetch the EndOfMediaVOB, possibly using multiple TCDR_GETs. The buffer is released each instance, but the transcoder need not copy the VOB information from the source buffer on the SetOption call, since the data is assured to be constant. For each EndOfMediaVOB, a EndOfMedia return is made with an empty buffer. The sequence may continue until a CloseDVDFilter call is made.

[0114] Referring to **FIGURE 10**, a sequence diagram illustrates interactions of a Simple Object Access Protocol (SOAP) media definition server that supports media tree modification. ClientTimeout (3) is supplied in case a client does not reset the timer. Any number of messages, for example shown as AddElement (4), DeleteElement (6), MoveElement (8), and Replace (10) may occur in any order and may be grouped in any number of (SOAP) envelopes. ResetTimer (12) is inserted since the timer is to be reset at specified intervals, or ModifyTree will end. CommitTree (16) denies other requests during ModifyTree. Timer messages are not used after commit and receive a fault return.

[0115] Referring to **FIGURE 11**, a use case diagram illustrates functionality of an audio-visual system that uses an emulator interface. The audio-visual system **1100** includes a server **1110** that is capable of executing on a processor and an emulator-enabled media player **1112**. The server **1110**

manages accessing and streaming of content to the emulator-enabled media player **1112**. The emulator-enabled media player **1112** receives content from the server **1110** and performs or presents the content. In a particular embodiment, the audio-visual system **1100** can be a video system that plays video content from one or more sources on an emulator-enabled DVD player.

[0116] The server **1110** has several functional blocks including a media server **1120**, a media renderer **1122**, a media controller **1124**, a media directory **1126**, and an emulator server **1128**. The media server **1120**, the media renderer **1122**, and the media controller **1124** contain specification elements, respectively a server element **1129**, a renderer element **1130**, and a control element **1132**. The specification elements comply with standard communication protocols.

[0117] The media controller **1124** and the media renderer **1122** include specialized control operations and rendering operations, respectively. For example, the media controller **1124** includes control functionality to select, enable, initiate and manage emulated interactions. The media renderer **1122** includes a specialized renderer that is a proxy for the emulator network communications server **1128**. The media controller **1124** communicates with the media server **1120** and the media renderer **1122** to initialize a source to supply content, set content transfer parameters, and begin content delivery. Media structure requests are sent to the media controller **1124**, and the media controller **1124** sends control signals causing the media server **1120** to transmit media files to the media renderer **1122** including functional elements in the media renderer **1122** that activate the emulator media stream.

[0118] The media controller **1124**, which may be termed a control point, examines the media directory **1126**, and specifies media menuing **1140**, for example DVD menuing, creating menus in the media directory **1126** concurrently with content transfer. The media directory **1126** contains some or all media content along with a list of available content for producing and displaying menus. A media provider **1002** makes media available to the media directory **1126**.

[0119] The media server **1120** receives control signals from the media controller **1124** and responds by supplying media content **1142** for rendering. The media renderer **1122** receives the control signals and adjusts the media to the emulated standard **1144**. The media renderer **1122** can render media player menus **1146** for presentation of the menu by the emulator-enabled media player **1112**. The media renderer **1122** receives and renders the content, supplying the rendered content **1148** to the emulator server **1128**.

[0120] The emulator server **1128** functions as an interface between the media renderer **1122** and the emulator-enabled media player **1112**. The emulator server **1128** conducts the media content stream **1050** from the media renderer **1122** to the emulator-enabled media player **1112** and receives control information from the emulator-enabled media player **1112** to permit discovery of available content **1052**.

[0121] In an illustrative example, the emulator-enabled media player **1112** includes an emulator **1114**, a media drive **1116**, and a content sink device **1118**. In a particular example, the media drive **1116** can be a DVD drive and the content sink device **1118** can be an MPEG decoder. Functions performed by the emulator **1114** mirror, or emulate, the functions of the media drive **1116**. In standard operation, the media drive **1116** supplies a media stream **1054** to the content sink device **1118** and requests a media description **1056**. The emulator **1114** emulates functions of the media drive **1116**, supplying an emulated media stream **1058**, and requesting a media description **1059**.

[0122] The emulator **1114** can use automatic Internet Protocol (IP) addressing to allocate reusable network addresses and configuration options.

[0123] The system may include a Dynamic Host Configuration Protocol (DHCP) server **1160** that supplies a framework for passing configuration information to hosts on a TCPIP network, based on a Bootstrap Protocol (BOOTP) that is known to those of ordinary skill in the art of network communication. The DHCP server **1160** adds a capability to automatically allocate reusable network addresses and additional configuration options **1162**. DHCP captures the behavior of BOOTP relay agents to enable DHCP participants to interoperate with BOOTP participants.

[0124] Media structure requests are sent to the control point **1124**. The media server **1120** transmits the media files to the renderer **1122**. The control point **1124** creates menus in real-time by examining the media directories **1126**.

[0125] Referring to **FIGUREs 12A** and **12B**, a flow chart and sequence diagram respectively illustrate operations of a boot Read-Only Memory (ROM). The boot ROM attains control over a client at power-on/reset and executes until control is passed to a downloaded software image. The boot ROM configures Ethernet media access control (MAC) and IP addresses and attempts to contact a local or remote code server to enable downloading of a Client software image. The boot ROM may also receive a client download via Intelligent Interface Controller (I2C) interfaces.

[0126] After MAC initialization and during network activity, boot ROM monitors the network cable and restarts network protocol activity when the cable becomes disconnected and reconnected.

[0127] All application-specific packets begin with a Zenith MUD Protocol (ZMP) header (ZMPHeader) defined as:

```
typedef struct ZMPHeader_s {
  unsigned char Op;
  unsigned char Sub;
  unsigned char ProtocolMajorVer;
  unsigned char ProtocolMinorVer;
  unsigned char Configuration;          // for Clients switch values for servers OS
  unsigned char pad;
  unsigned char Retries;                // attempts to perform the function
  unsigned char Time;                   // for ROM centisecs since reset, all others
```

```
} ZMPHeader;
```

[0128] The first element, "Op", specifies the major classification of the packet, enabling efficient steering of a packet to a proper handler upon reception.

```
enum ZMP_OP_Codes {
  ZMP_AutoMac        = 1,    // ZMP_Request, ZMP_Reply
  ZMP_LocalBoot      = 2,    // request configuration: ZMP_Request, supply config:
  ZMP_InetDiscovery  = 3,    // code directory request on the Internet
  ZMP_ServerDiscovery= 4,
  ZMP Media          =5,
  ZMP_CodeRequest    = 6,    // sub=ZMP_Download for local download
  ZMP_MAESTROBEACON= 0xA0,          // sent only by MBOOTP server
  ZMP_ MAESTROREQUEST= 0xAl,        // sent only by client ROM
  ZMP_MAESTROREPLY= 0Xa2,           // sent only by MBOOTP server
};
Typedef ZMP_OP_Codes ZMPOPCodes ;
```

[0129] The second element, "Sub", specifies a particular action within a packet's Op classification.

```
enum ZMP_Sub_Codes {
  ZMP_Request        = 1,
  ZMP_Reply          = 2,
  ZMP_MediaPort      = 3,
  ZMP_Download       = 4,
  ZMP_DISCOVER       = 5,    // client -> server
  ZMP_OFFER          = 6,    // server-> client
  ZMP_REQUEST        = 7,    // client -> server
  ZMP_DECLINE        = 8,    // client -> server
  ZMP_ACK            = 9,    // server-> client
  ZMP_NACK           = 10,   // server-> client
  ZMP_RELEASE        = 11,   // client -> server
  ZMP_Beacon         = 12,
  ZMP CodeServerList = 13
};
Typedef ZMP_Sub_Codes ZMPSubCodes ;
```

[0130] The boot ROM attempts to locate a local server by making a local boot server request, via broadcast of a ZMPmbootp request. Requests are initiated in parallel with AutoMAC since a server can supply a MAC address for the client. Requests can be spaced at increasing time intervals for multiple requests to avoid network congestion for competing clients. Requests continue until a local server responds or a client software image is downloaded from another source. Boot ROM current values for MAC and IP are specified by the request packet. A server may respond with client IP, MAC, and Gate information. Non-zero values returned by the server in any of the fields can be adopted by the client boot ROM. An embodiment of a request packet format is as follows:

```
typedef struct ZMPmbootp_s {        // configure client from local server:
                                    // ZMP_LocalBoot:ZMP_Request/ZMP Reply
  ZMPHeader Header;
  Unsigned int Xid;                 // Transaction set by client
  Unsigned int UniqueIdentifier;    // Set by client to further self-identify
  Unsigned int IP;                  // client IP address
  Unsigned int IPMask;              // Mask for the local network
  Unsigned int IPGate;              // Gate to the Internet
  unsigned short Flags;             // not used
  unsigned char Hw_addr[HW_ADDR_LEN]; // client's HW (MAC) address
} ZMPmbootp;
```

[0131] AutoMAC protocol enables clients to autonomously select a MAC address from a selected address range. An example of an AutoMAC request packet follows:

```
typedef struct ZMPSqueal_s {        // Self-configure MAC address:
                                    // ZMP_AutoMAC:ZMP_Request/ZMP_Reply
  ZMPHeader Header;
  unsigned int Xid;                 // Transaction set by client
  unsigned int UniqueIdentifier;    // Set by client to further self-identify
  unsigned char Flags;              // bit-0: 1 for last squeal
  unsigned char pad;
  unsigned char Hw_addr[HW_ADDR_LEN]; // candidate's address
} ZMPSqueal;
```

[0132] One operation involves random selection of an in-range MAC address, then sending of multiple ZMPSqueal requests and listening for replies. Any replies indicate that the given MAC address is already in use and a new random MAC address is to be tested. ZMPSqueal requests are sent multiple times with a selected delay between requests. If no replies are received, the candidate MAC address is adopted. If a reply is received before the sequence completes, the candidate MAC is abandoned and a new random candidate MAC address is selected, and the sequence is restarted. If at any point a server supplies a client MAC address, the AutoMAC operation is terminated.

[0133] If no server and/or DHCP server is detected, Automatic Private IP Addressing Protocol (APIPA) supplies a client IP address, enabling a client to connect to a similarly configured host.

[0134] A ZMPCodeRequest packet is sent to a server to initiate download of a client software image. The core of the request packet is a TFTP request header which includes the file name of a desired client software image. Subsequent data transfer and acknowledge packets follow the TFTP protocol specification. The downloaded image can be DSA-signed. The signature is validated and, if invalid, the boot ROM restarts operation. An example of a TFTP read request follows:

```
//TFTP read request
struct tftp_rrq {
  unsigned short cmd;               // TFTP_RRQ
                    // ASCIIZ filename followed by ASCIIZ "binary" file type
  unsigned char
```

```
    filename_mode[TFTP_MAX_FILENAME_LEN+1+TFTP_MAX_MODE_LEN+1];
    };


typedef struct ZMPCodeRequest_s {
    ZMPHeader Header;
    int   Blocksize;
    struct tftp_rrq   InitialRequest;

} ZMPCodeRequest;
```

[0135] The boot ROM requests a filed with a name encoded in a specified manner. The boot ROM contacts remote directory servers at one or more IP addresses if the local download is not complete within a specified time after MAC and IP configuration. A request with opcode:ZMP_InetDiscovery, subcode:ZMP_Request is sent to each of the defined IP addresses and if a response is received, the response packet will include one or more code-server IP/Port addresses that can be contacted to enable download of a client software image. An example of a request follows:

```
typedef struct codeServerDescription_s {
    unsigned int Ip;              // IP to the code server
    unsigned short port;          // port to contact the server
    unsigned short flags;         // unused
} CodeServerDescription;
```

[0136] All defined code addresses are queried with overlapping requests with multiple attempts and a specified timeout period. Requests are spaced in time to throttle gateway activity. The request includes only the ZMP header, while the reply includes the ZMPCodeServer payload defined as follows:

```
//Request opcode:ZMP_InetDiscovery      subcode:ZMF_Request
//Replyopcode:ZMP_INetDiscovery         subcode:ZMP_Reply

typedef struct ZMPCodeServer_s {
    //Request opcode:ZMP_InetDiscovery        subcode:ZMP_Request
    // Reply   opcode:ZMP_InetDiscovery       subcode:ZMP_Reply
    ZMPHeader  Header;
    // the following structures repeat to the end of the reply packet
    CodeServerDescription Servers;
} ZMPCodeServer;
```

[0137] Any servers returned in replies are queued and contacted to request a Client software image download. Remote activity is only attempted if a gateway is specified via DHCP or remote server configuration.

[0138] Referring to **FIGURE 13A**, a schematic state diagram depicts an embodiment of drive

controller **1300**, such as the drive controller **162** shown in **FIGURE 1**. States in the drive controller **1300** state diagram include an idle media tray out state **1302**, an idle no media state **1304**, and an idle have media state **1306**. On initialization, the boot ROM sets up the interface **1308**, for example an Integrated Drive Electronics (IDE) interface. In each state, the drive controller responds to a sense command **1310**.

[0139] Referring to **FIGURE 13B**, a flow chart illustrates an embodiment of drive interface operations.

[0140] In an illustrative embodiment, the client can have a server interface such as a Transmission Control Protocol (TCP) interface. The TCP interface is a simple socket with the client transmitting command packets and the server replying with the command packet specifying media state. The server responds by transmitting the requested number of data blocks. An example of a request block follows:

```
struct tNetCRB {
  unsigned int      size;        // Total size of the packet+data to transfer
  unsigned char   device,      // Destination device COMSID
                  command;  // Command to issue on server
  union {
        unsigned char  cdb[12];          // CDB, if needed
        unsigned char  sticky;           // Sticky bit - data should remain
};
  unsigned int     lba;          // Logical Block Address to read
  unsigned int     count;        // Count of sectors to read
  unsigned short   blocksize;    // Size of sector to read
  unsigned int     fileSize;     // Size of file being transferred
  unsigned int     bufferSize;   // Size of data that follows, or of receiving buffer
  unsigned int     encryptionID;
  unsigned int     stickyBlocks[MAX_StickyBlocks][2];  // Blocks always cached
  unsigned short   iStack;                             // Stack pointer
  unsigned short   mediaStack[MAX Media5tack];         // Media stack
};
```

[0141] The mediaStack is not examined by the client but rather is state information that is acted upon only by the server.

[0142] Referring to **FIGURE 13C**, a schematic flow chart illustrates an embodiment of operations performed by the client to implement UDP protocol communication, enabling rapid packet transmission without TCP overhead. The command channel is implemented over a TCP socket and data is transmitted over a UDP socket. The server tags each UDP transmission with a buffer position pointer. The pointer is used to place data into the buffer and assure that all packets arrive. Both the server and client have active timeouts coupled to retries in case of dropped packets. The number of packets between acknowledgements and the packet size are variable.

[0143] Referring to **FIGURE 14A**, a schematic block diagram illustrates an embodiment of a

media arrangement **1400** that can be used by the system. A Virtual media volume **1402** presents a "virtual" format to a user device, enabling navigation and play of the media in a user-friendly manner that is familiar to the user. Stack frames are held in a Video Title Set (VTS) stack **1404** by a client to preserve media space position. The navigation information enables a history mechanism within the user device to operate in a manner familiar to a user. Media descriptors **1406** associate stack frames to the media tree in VTS Tasks in a structure that enables the system to audit play histories and dynamically adjust storage resources and processor demands. Frequently-viewed material is automatically cached after first conversions to the user device's native format.

[0144] **FIGUREs 14B** and **4** depict two views of the media, respectively a root media directory **1420** and a media tree **400**. The two views express the media organization within the media delivery system, illustrating to the user device the manner in which the media can be distributed among multiple resources. The system dynamically and user-transparently configures the user interface by self-organizing the media, deriving navigation information by the location to the pieces of media in relation to one another. Media directories **1422** containing multiple pieces of media become menus and media pieces become source for selection of a user interface on the user device. **FIGURE 14C** depicts linked menus representing the same media pieces as depicted in **FIGURES 14B** and **4**, with the linked menus emphasizing scattering of the media pieces across multiple networks. The derived navigation information, in particular the menus, hold the linking information.

[0145] A player plays a single Title Set repeatedly while the system can substitute media from the distributed file system in that single Title Set, called Root Video Title Set (VTS) **1408**. The VTS Stack 1404 preserves a user's position within the media tree **400** shown in **FIGURE 4** and the VTS File Table **1410** maps that position to a particular position in the media navigation tree **400**. Stack frames are held by a client to preserve media space position. The navigation information enables the history functionality operative within the user device to operate in a manner that is typical for the user device, and generally known to the user. Media descriptors associate the stack frames to the media tree **400** in a structure that enables the system to audit play histories and dynamically adjust storage resources and processor demands. Frequently-viewed material can be automatically cached after first conversions to user device native format.

[0146] The linked menu diagram shown in **FIGURE 14C** describes a Linked Menu Convention (LMC) which enables the transcoder and the client to present to the user a series of menus with a consistent look and feel. Navigation control and information is derived from file arrangements, enabling dynamic and user-transparent configuration of the user interface and dynamic access to selected content and sources. Directories become menus and media become buttons within the menus. If too large a number of media items are contained within a directory, a chaining of a series of menus is generated which appears to the user as successive menus that are familiar to the user. For example, for

a user device that is a DVD player, the directories are presented in the form ofsuccessive DVD menus following the convention of DVD user interfaces. The convention is based upon the order of the button structures conveyed to the client in the eXtended Markup Language (XML) description of the media tree **400**. The media tree **400** is coupled with the use of the GPRM's of the media player state machine, for example a DVD state machine, to enable self-contained free-standing media menu pages to appear to be mutually linked in a consistent and intuitive human interface. The convention groups any number of the separate menu pages into a menu set. A menu set is a group of menus that all are mutually inter-referenced and automatically transition to one another as the user depresses the arrow keys on the remote control.

[0147] The actions are based on conventions and attributes in the XML that describes the menu pages and the manner in which the elements are presented to the menu transcoder in the media system. A basic aspect of the convention is implementation of the automatic action button that is a native component of the media button specification. The automatic action button, for example may be a DVD button, which does not require the user to select the button for media state machine action to occur. Simply the action of the user to move a cursor to the button or "highlight" the button, is sufficient for the player to take an action, just as though the user had highlighted the button and then depressed the select or play button on the remote control.

[0148] The linked menu convention uses two additional attributes in the button element and one additional attribute for the menu element. The additional attributes in the button element include "AutoButton", a simple true-false Boolean attribute indicating the button is an automatic action button, and DestID, a transitions destination menu that enables transitions out of the normal menu hierarchy. DestID attribute holds the reference identifier IDREF of the destination menu, media, for example video, music, slideshow element, or the like, that is the target of the automatic action. IDREF is a unique identifier in the identifier attribute of every XML element. The menu element attribute is TCDR LinkedMenu, a simple Boolean contained in the menu element attribute list and that is inferred to be false if absent from the menu element.

[0149] In an illustrative embodiment of the XML menu description for implementation of the Linked Menu Convention, the button presentation order in the menu XML element has meaning. For example in one implementation the first displayed button in the menu is an automatic-action button called an up button that, when highlighted, immediately executes a jump to the DestID element. The second button is the first media button in the Z order of the menu page. Whenever a jump is performed from a down auto-button of another Linked Menu Convention (LMC) menu within the set, the second button is the button on the new menu page that is highlighted. The last button in a menu belonging to a menu set is an automatic-action button called a down button that, once highlighted, immediately executes a jump to the next menu in the menu set. The last button in the navigation Z order of a LMC

menu has a btnDown attribute that points to the LMC down button. No other non-automatic-action buttons can be positioned between this last media button and the final button specified on the menu, enabling a menu transcoder to easily select the button for inter-LMC menu navigation.

[0150] The last button of a menu is highlighted when a LMC menu is entered through the previous LMC's up button action in a redirection that is performed through a program incorporated into the IFO's of all LMC menus. For example, DVD players generally have a set of general purpose registers called GPRMs, and a set of special purpose registers called SPRMs. The LMC uses GPRM 1 to store the last media selection button. SPRM 8 is used to select a menu button for highlighting. The DVD program in the LMC menu IFO checks SPRM 8 to determine whether the previous menu's up button, for example button 1 in the Z order, has selected the menu. If so, the IFO program copies GPRM 1 into SPRM 8, causing the last media button of the newly selected LMC menu to be highlighted. The DVD IFO program then installs a last media button associated with the IFO program into GPRM 1 for the next transition in the LMC.

[0151] The buttons are contained within VTS Title Sets that are generated at the time media is added to the system. Because the menuing is developed in real-time using the transcoding process as the media tree changes, transcoders are also created to revise the menus that are affected by a change, deletion, or addition of media at the time the altered media state is encountered.

[0152] As shown in **FIGURE 14C**, buttons 1, 5, 6, and 7 have the autoaction flag set, while buttons 2, 3, and 4, shown with heavy lines, are not auto-action. Button 2 is always the first media button. Button 4 is set into GPRM1 on entry to the menu.

[0153] Referring to **FIGURE 14D**, a flow chart illustrates an embodiment of a code segment added to program code for information format (IFO) in cases that TCDR LinkedMenu option is called on a transcoder. The call is made before any buttons are added to the transcoder.

[0154] The button element can be specified to include rightButton, leftButton, upButton, and downButton, that are declared for a particular application and can be implemented in XML as nvldRight, nlvdLeft, nvldUp, and nvldDown. The elements can be used to transfer button Z order to the menu transcoder and reference buttons in the order of appearance in the menu element. The button elements can be used as button destinations for passing the menu definition structure to the menu transcoder. In an illustrative embodiment, an LMC menu can be specified in XML as:

```
<menu id="menul" TCDR_LinkedMenu="true"??>
  <button id="2" nvld="1" AutoButton="true" DestID="menu3"??/> <button
  id="3" nvld="2" nvldUp="1" nvldDown="3"??/>
      <video??/>
  <button id="4" nvld="3" nvldUp="2" nvldDown="4"??/>
      <video??/>
  <button id=" 5" nvld="4" AutoButton="true" DestID="menu3"??/>
</menu>
```

```
<menu id="menu2" TCDR_LinkedMenu="true"??>
  <button id="26" nvld="1" AutoButton="true" DestID="menu 1"??/>
  <button id="27" nvld="2" nvldUp="1" nvldDown="3"??/>
     <video??/>
  <button id="28" nvld="3" nvldUp="2" nvldDown="4"??/>
     <video??/>
  <button id="29" nvld="4" AutoButton="true" DestID="menu3"??/>
</menu>

<menu id="menu3" TCDR_LinkedMenu="true"??>
  <button id="32" nvld="1" AutoButton="true" DestID="menu2"??/> <button
  id="33" nvld="2" nvldUp="1" nvldDown="3"??/>
     <video??/>
  <button id="34" nvld="3" nvldUp="2" nvldDown="4"??/> <video??/>
  <button id="35" nvld="4" AutoButton="true" DestID="menul"??/> </menu>
```

[0155] Referring to **FIGURE 15**, a schematic block diagram illustrates an embodiment of an eXtended Markup Language (XML) media schema **1500**. In an illustrative embodiment, the number of media elements is kept to a minimum to facilitate implementation and maintenance of XML compiler components of the server. Elements include one container called a disc element **1502**, two navigation elements termed menu **1504** and button **1506** elements, and two media elements, video **1508** and slides **1510**.

[0156] Referring to **FIGURE 16**, a detailed block diagram depicts functional blocks of an emulation circuit **1600** that is suitable for usage in the emulator interface. In some embodiments, the emulation circuit **1600** can be implemented as a field programmable gate array, although other technologies may otherwise be used. The emulation circuit **1600** includes a processor **1610** that can be programmed to execute various functions including control, data transfer, emulation, transcoding, data storage, interface, test, and others. In an illustrative embodiment, the processor **1610** can be implemented as an ARM7TDMI-S manufactured by Advanced RISC Machines, United Kingdom. The illustrative processor **1610** further includes an in-circuit emulator **1612** and a Test Access Port (TAP) controller **1614**.

[0157] The in-circuit emulator **1612** can support real-time debug with trace history around a trigger point, debugging of foreground tasks simultaneous with background task execution, and modification of memory during runtime. In-circuit emulator **1612** can also support multiple processors and mixed architecture devices, slow or variable-frequency designs, and debug of very low-voltage cores.

[0158] The TAP controller **1614** is coupled to a JTAG interface **1616**, enabling the processor **1610** to execute JTAG emulation that allows the processor **1610** to be started and stopped under control of connected debugger software. JTAG emulation allows a user to read and modify registers and memory locations, set breakpoints and watchpoints, and support code download, trace, and monitoring for debug operations.

[0159] The processor **1610** and an AHB bus interface **1618** communicate on an ARM memory bus **1620**. The AHB bus interface **1612** communicatively couples the processor **1610** to a multi-layer Advanced Microcontroller Bus Architecture AMBA? high-speed bus (AHB) **1622**. AHB matrix **1626** is also coupled to the AHB **1622**. The AHB Matrix **1626** is a complex interconnection matrix to attain parallel paths to memory and devices on the multi-layer AMBA? high-speed bus (AHB) **1622**. The parallel paths of the AHB **1622** increase bus bandwidth and lower latencies by reducing contention. Multi-layer AHB **1622** is an interconnection technique based on AHB protocol that supports parallel access between multiple master and slave devices.

[0160] Devices coupled to the AHB **1622** include an interrupt controller **1624**, a static memory controller **1628**, a test interface controller **1630**, a cache controller **1632**, an AHB to PVCI bridge **1650**, and an AHB to BVCI bridge **1652**. The interrupt controller **1624** is capable of detecting interrupt signals from one or more sources including an external interrupt connection **1636**, timers **1638**, a media access control (MAC) module **1640**, an ATAPI device block **1642**, and a host ATA control block **1644**. The interrupt controller **1624** asserts an appropriate bit identifying an interrupt on the processor **1610** upon the occurrence of one or more interrupt **signals.** In various applications, the current highest priority interrupt can be determined either by software or hardware. Typically, the current highest priority interrupt is read from a set of registers in the interrupt controller **1624**. The interrupt controller **1624** contains registers indicative of interrupt status, and registers for enabling and setting interrupts.

[0161] The static memory controller **1628** is coupled to a flash memory interface **1646**, typically for supplying program code that is executable on the processor **1610** although data and other information can also be supplied to the emulation circuit **1600**.

[0162] The test interface controller **1630** is coupled to a test interface **1648** and supports external bus interface request and grant handshake signals for requesting test interface access to an external bus and information of external bus use grant, respectively. In a typical system, the processor **1610** may continually request access to an external bus with the test interface controller **1630** having highest priority to bus access. In a typical sequence of events to apply test patterns, first reset is asynchronously applied and synchronously removed. On reset removal, processor **1610** initiates a memory read via the static memory controller **1628**. The static memory controller **1628** typically requests the external bus and reads the bus when the request is acknowledged. When the static memory controller **1628** is busy, the test interface controller **1630** can request the external bus. The request is granted because the test interface controller **1630** has the highest priority and the test interface controller **1630** takes ownership of the external bus. When the static memory controller **1628** finishes the read access, the test interface controller **1630** is granted use of the external bus. The external bus resolves the bus request signals and the test interface controller **1630** initiates a test

pattern sequence.

[0163] The cache controller **1632** is coupled to a cache memory **1634**, illustratively 4kB of static RAM. The cache memory **1634** reduces external memory accesses and increases performance even with usage of relatively low-speed RAM. The cache memory **1634** allows processor **1610** to share bus bandwidth with multiple devices with high data throughput such as streaming audio and video devices.

[0164] The AHB to PVCI Bridge **1650** couples Peripheral Virtual Component Interface (PVCI) functional blocks to the AHB **1622**. The AHB to PVCI bridge **1650** can include both master and slave interfaces and supports AHB Master to PVCI Slave and PVCI Master to AHB Slave modes. The PVCI standard enables development of plug-in components that are compatible with numerous interfaces, promoting design efficiency. In the illustrative example, PVCI devices coupled to a register bus **1656** include timers **1638**, MAC module **1640**, a general purpose input/output interface **1654**, ATAPI device block **1642**, and host ATA control block **1644**.

[0165] The AHB to BVCI Bridge **1652** couples Basic Virtual Component Interface (BVCI) functional blocks to the AHB **1622**. The Basic Virtual Component Interface (BVCI) is a system bus interface to a memory bus **1658**. In the illustrative example, BVCI devices coupled to the AHB to BVCI bridge **1652** include the host ATA control block **1644**, the ATAPI device block **1642**, and a synchronous dynamic RAM (SDRAM) interface **1668**.

[0166] Timers **1638** can be programmed to time various events under program control. The processor **1610** controls operation of timers **1638** through signals communicated to timer registers via the register bus **1656**. The timers **1638** can generate timer interrupts that can redirect program execution through operation of the interface controller.

[0167] The emulation circuit **1600** receives and sends data or information by operation of the general purpose input/output interface **1654** that is coupled between the register bus **1656** and a GPIO interface **1662**.

[0168] In the illustrative emulation circuit **1600**, the MAC module **1640** is a 10/100-MBPS Ethernet media access controller for networking highly integrated embedded devices. The MAC module **1640** is coupled to an external network interface **1660**, as well as to the register bus **1656** and the memory bus **1658**. The MAC module **1640** is an interface to physical layer devices and can support 10-BaseT, 100-BaseTX, 100-BaseFX, and 32-bit standards-based BVCI bus interface with an integrated direct memory access (DMA) controller. The MAC module **1640** is typically IEEE 802.3 compliant and supports half- and full-duplex operation with collision detection, auto-retry, flow control, address filtering, wakeup-on-LAN, and packet statistics. MAC module **1640** can incorporate a DMA buffer-management unit and support wire-speed performance with variable packet sizes and buffer chaining. MAC module **1640** can offload processor tasks including such

direct register access and programmable interrupts to improve high data throughput with little processor overhead. The MAC module **1640** can generate interrupts and includes an interrupt signal connection to the interrupt controller **1624**.

[0169] The host ATA control block **1644** and the ATAPI device block **1642** are coupled to the register bus **1656** and the memory bus **1658**, and operate in combination to facilitate connectivity between a host controller and hard disk drives in various applications including computing, communication, entertainment, peripheral, and other applications. The host ATA control block **1644** includes digital circuitry to form a complete ATA host subsystem to integrate hard disk, CD-ROM, DVD, DVD-R, and other host subsystems. The host ATA control block **1644** implements functionality for drive control and enables the emulation circuit **1600** to operate as a host. When the emulator **1600** functions as a host to control a storage drive the host uses functionality of host ATA control block **1644** and host ATA interface **1664**. The host ATA control block **1644** can also implement programmed input-output (PIO), multiple-word direct memory access (DMA), and various speed, for example 33, 66, 100, and 133 megabyte/second, interface circuitry. In various embodiments, the host ATA control block **1644** can support multiple ATA/ATAPI devices. The host ATA control block **1644** is coupled to a host ATA interface **1664** for connecting to a host computer and has an interrupt connection to the interrupt controller **1624** so that the processor **1610** can address host ATA interface events.

[0170] The ATAPI device block **1642** is coupled to a device ATA interface **1666** and connects an Integrated Device Electronics (IDE) storage device to a host system. The ATAPI device block **1642** typically performs command interpretation in conjunction with the embedded processor **1610**. The ATAPI device block **1642** implements functionality of storage drive emulation, enabling the emulation circuit **1600** to function as a storage drive. An external device can operate as a host that uses the emulation circuit **1600** as a drive. The ATAPI device block **1642** can be used to communicate with hard disk drives as well as solid-state storage devices using dynamic RAM (DRAM), NAND, or NOR flash memory devices, and the like. In various embodiments, the ATAPI device block **1642** can be designed to interface to one or more of various size (for example 1 ", 1.8", and 2.5") hard disk drives, low-power drives, portable drives, tape drives, and solid-state or flash drives. The ATAPI device block **1642** has an interrupt connection to the interrupt controller **1624** so that the processor **1610** can address device ATA interface events.

[0171] The host ATA interface **1664** can be logically connected to the device ATA interface **1666**. In one example, the emulation circuit **1600** can function as a MPEG decoder communicating directly with a storage drive. In a pass through operation, the emulator circuit **1600** can monitor commands sent to a storage drive passively.

[0172] The SDRAM interface **1668** is an interface controller that supports interconnection of

the emulation circuit **1600** to synchronous dynamic RAM modules in various configurations, for example DIMM, without supporting circuitry. The SDRAM interface **1668** typically includes a SDRAM controller (not shown) and a SDRAM configuration block (not shown). The SDRAM controller generates control signals for controlling the SDRAM. The SDRAM configuration block includes configuration registers for controlling various entities such as refresh and mode lines, and a refresh timer for usage by the SDRAM controller. In various embodiments, the SDRAM interface **1668** SDRAM) interface **1668** can support slave devices, arbitrary length bus transfers, and programmability.

[0173] While the invention has been described with reference to various embodiments, it will be understood that these embodiments are illustrative and that the scope of the invention is not limited to them. Many variations, modifications, additions and improvements of the embodiments described are possible. For example, those having ordinary skill in the art will readily implement the steps necessary to provide the structures and methods disclosed herein, and will understand that the process parameters, materials, and dimensions are given by way of example only. The parameters, materials, and dimensions can be varied to achieve the desired structure as well as modifications, which are within the scope of the invention. Variations and modifications of the embodiments disclosed herein may be made based on the description set forth herein, without departing from the scope and spirit of the invention as set forth in the following claims.

WHAT IS CLAIMED IS:

1. An apparatus for handling media content comprising:
an interface that couples to and acquires content from one or more sources including network-coupled sources and/or locally-coupled sources, the one or more sources supplying various content;
a user interface; and
a controller that dynamically configures a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.

2. The apparatus according to Claim 1 wherein the controller automatically initiates user interface configuration in response to engagement of the apparatus with the one or more sources.

3. The apparatus according to Claim 1 wherein the controller configures the user interface in content groups.

4. The apparatus according to Claim 1 further comprising:
the interface that acquires the content from the one or more sources in a plurality of different formats;
a transcoder that converts the content to a common format for presentation; and
a client device that presents the content in a client device common format.

5. The apparatus according to Claim 4 wherein:
the conversion is user-transparent.

6. The apparatus according to Claim 1 further comprising:
said interface that acquires the content from the one or more sources in a plurality of different formats;
a decoder that decodes the content into a format compatible for presentation; and
a client device that presents the content in a client device common format.

7. The apparatus according to Claim 6 wherein the decoder is selected from among a group comprising:
multiple client-resident decoders; at least one programmable client-resident decoder reconfigured by downloading multiple versions of client-resident decoder code; and
decoder code downloaded in combination with content.

8. The apparatus according to Claim 1 further comprising:
a server executable on the controller that derives navigation information based on relative location of content elements on the one or more sources and organizes the content from the navigation information.

9. The apparatus according to Claim 1 further comprising:
a client device; and
a server executable on the controller that arranges content elements and navigation information in virtual media volumes forming a distributed file system and including a single title set, the client device repeatedly playing the single title set as the server substitutes content from the single title set.

10. The apparatus according to Claim 9 further comprising:
the distributed file system including a Video Title Set (VTS) stack and a VTS file table,
the VTS stack that preserves a user's position within a media tree and the VTS file table mapping the user's position to a location in a media navigation tree.

11. The apparatus according to Claim 10 further comprising:
stack frames in the VTS stack that are held by a client to preserve media space position, the server using media descriptors to associate stack frames to the media tree.

12. An apparatus for handling media content comprising:
a client device; and
a server that arranges content elements and navigation information in virtual media volumes forming a distributed file system and including a single title set, the client device repeatedly playing the single title set as the server substitutes content from the single title set.

13. The apparatus according to Claim 12 further comprising:
the distributed file system including a Video Title Set (VTS) stack and a VTS file table, the VTS stack that preserves a user's position within a media tree and the VTS file table mapping the user's position to a location in a media navigation tree.

14. The apparatus according to Claim 13 further comprising:
stack frames in the VTS stack that are held by a client to preserve media space position, the server using media descriptors to associate stack frames to the media tree.

15. A content handling method comprising:
acquiring content from one or more sources including sources capable of network connection and/or sources capable of local connection, the content and sources being capable of dynamic change; and
dynamically configuring a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.

16. The method according to Claim 15 further comprising:
engaging a user device for usage with the user interface with the one or more sources; and
automatically configuring the user interface in response to the engagement.

17. The method according to 15 further comprising:
configuring the user interface in content groups.

18. The method according to Claim 15 further comprising:
acquiring the content from the one or more sources in a plurality of different formats; and converting the content to a common format for presentation, the conversion being user transparent; and
presenting the content in the common format on a user device.

19. The method according to Claim 15 wherein:
the user device and at least one of the local connection sources are consumer electronics devices.

20. The method according to Claim 15 further comprising:
acquiring the content from the one or more sources in a plurality of different formats; and
processing the content into a format compatible for presentation; and
presenting the content in the common format on a user device.

21. The method according to Claim 15 further comprising:
deriving content navigation information from relative location of content items.

22. The method according to Claim 15 further comprising:
organizing the content based on the derived content navigation information.

23. The method according to Claim 15 further comprising:
arranging content items in a tree structure of directories; and
displaying the directories as a menu for source selection by the user.

24. The method according to Claim 23 further comprising:
using the arranged content items as a source for a user interface selection on the user device.

25. The method according to Claim 15 further comprising:
arranging the content items in a tree structure of directories distributed across multiple networks.

26. An apparatus for handling media content comprising:
an interface that couples to and acquires content from one or more sources including network-coupled sources and/or locally-coupled sources, the one or more sources supplying various content; and
a controller that derives navigation information from the one or more sources based on relative location of the sources and organizes the content into an internal map mutually relating the sources.

27. The apparatus according to Claim 26 further comprising:
a user interface coupled to the controller, the controller that arranges content items in a tree structure

of directories and displays the directories via the user interface as a menu.

28. The apparatus according to Claim 27 further comprising:
a client device coupled to the controller, the controller that uses the arranged content items as a source for user interface selection on the client device and arranges the content items in a tree structure of directories distributed across multiple networks.

29. A content handling method comprising:
deriving navigation information from one or more sources including sources capable of network connection and/or sources capable of local connection based on relative location of the sources; and
organizing the content into an internal map mutually relating the sources.

30. The method according to Claim 29 further comprising:
arranging content items in a tree structure of directories; and
displaying the directories as a menu for source selection by the user.

31. The method according to Claim 30 further comprising:
using the arranged content items as a source for a user interface selection on the user device.

32. The method according to Claim 31 further comprising:
arranging the content items in a tree structure of directories distributed across multiple networks.

33. A server comprising:
a media monitor that supplies streaming content media from one or more various media content sources;
a virtual media driver that arranges and stores the media content in a virtual file structure;
a media server that presents content media of various types to the virtual media driver; and
a processor that acquires content from the one or more sources via the media monitor, evaluates acquired content form for definition of further content processing to a form that can be presented on a client, and processing the acquired content into a form that can be presented on the client, the acquisition, evaluation, and processing being user-transparent.

34. The server according to Claim 33 wherein the processor transcodes the content into a form that can be presented on the client.

35. The server according to Claim 33 further comprising:
one or more server-resident decoders capable of converting the content into a form that can be presented on the client, wherein the processor selects from the one or more decoders.

36. The server according to Claim 33 further comprising:

one or more programmable server-resident decoders, wherein the processor reconfigures a decoder of the one or more decoders by downloading a version of server-resident decoder code separately or in combination with content, the one or more decoders that convert the content into a form that can be presented on the client.

37. The server according to Claim 33 wherein:
the content and sources are capable of dynamic modification.

38. The server according to Claim 33 wherein:
the media monitor supplies streaming content from one or more sources including sources capable of network connection and sources capable of local connection.

39. A content handling method comprising:
acquiring content from one or more sources, the content and sources being capable of changing dynamically;
evaluating acquired content form for definition of further content processing to a form that can be presented on a user device; and
processing the acquired content into a form that can be presented on the user device, the acquisition, evaluation, and processing being user-transparent.

40. The method according to Claim 39 further comprising:
transcoding the content into a form that can be presented on a client.

41. The method according to Claim 39 further comprising:
selecting from one or more of multiple, server-resident, decoders for use to convert the content into a form that can be presented on the client; and
decoding the content using the selected decoder.

42. The method according to Claim 41 further comprising:
downloading one or more versions of server-resident decoder code separately or in combination with content; and
reconfiguring the one or more decoder code versions according to the downloading to effect conversion of the content into a form that can be presented on a client.

43. The method according to Claim 42 further comprising:
acquiring the content from one or more sources including sources capable of network connection and sources capable of local connection, the content and sources being capable of dynamic change.

44. The method according to Claim 42 further comprising:
dynamically configuring a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.

45. The method according to Claim 42 further comprising:
deriving content navigation information from relative location of content items; and organizing the content based on the derived content navigation information.

46. The method according to Claim 42 further comprising:
arranging content items in a tree structure of directories;
displaying the directories as a menu for source selection by the user; and
using the arranged content items as a source for a user interface selection on the user device.

47. The method according to Claim 42 further comprising:
arranging the content items in a tree structure of directories distributed across multiple networks.

48. The method according to Claim 42 further comprising:
generating a virtual media volume for presentation to the user device, the virtual media volume being a distributed file system;
continuously replaying a single title set of the virtual media volume; and
dynamically substituting media from the distributed file system in the single title set.

49. The method according to Claim 42 further comprising:
converting the acquired content into the form presentable on the user device in real time.

50. A content handling method comprising:
generating a virtual media volume for presentation to a user device, the virtual media volume being a distributed file system;
continuously replaying a single title set of the virtual media volume; and
dynamically substituting media from the distributed file system in the single title set.

51. An apparatus for handling media content comprising:
an interface that couples to and acquires use and navigation information from at least one content source in one or more formats;
a user interface; and
a controller that incorporates the use and navigation information into a menuing display of the user interface and accesses content from the at least one source based on the use and navigation information, the acquisition, incorporation, and access being user-transparent.

52. The apparatus according to Claim 51 wherein:
the controller generates a distributed file system virtual media volume for presentation to the user interface and derives navigation information from file arrangement of the distributed file system.

53. The apparatus according to Claim 51 wherein:

the controller generates directories in a distributed file system and displays directories via the user interface as menus whereby media content elements are displayed as menu buttons.

54. The apparatus according to Claim 51 wherein:
the at least one content source includes sources capable of network connection and sources capable of local connection, the content and sources being capable of dynamic change.

55. The apparatus according to Claim 51 wherein:
the use and navigation information changes intermittently; and
the controller updates the menuing display in real-time in response to the intermittently changed use and navigation information.

56. A content handling method comprising:
acquiring use and navigation information from at least one content source in one or more formats;
incorporating the use and navigation information into a menuing display of a user device; and
accessing content from the at least one source based on the use and navigation information, the acquisition, incorporation, and access being user-transparent.

57. The method according to Claim 56 further comprising:
generating a virtual media volume for presentation to the user device, the virtual media volume being a distributed file system; and
deriving navigation information from file arrangement of the distributed file system.

58. The method according to Claim 56 further comprising:
generating directories in a distributed file system; and
displaying directories as menus whereby media content elements are displayed as menu buttons.

59. The method according to Claim 56 further comprising:
the at least one content source includes sources capable of network connection and sources capable of local connection, the content and sources being capable of dynamic change.

60. The method according to Claim 56 wherein the use and navigation information changes intermittently, the method further comprising:
updating the menuing display in response to the intermittently changed use and navigation information.

61. The method according to Claim 60 further comprising:
updating the content form in real-time.

62. An apparatus for handling media content comprising:

an interface between a plurality of content sources and at least one sink device; and
a controller coupled to the interface that determines format or formats of content on the plurality of content sources and processes the format or formats to a format compatible with the at least one sink device without user interaction.

63. The apparatus according to Claim 62 wherein:
the interface couples to and acquires content from one or more sources including network-coupled sources and locally-coupled sources, the one or more sources supplying content of multiple various types.

64. The apparatus according to Claim 62 wherein:
the controller evaluates acquired content form for definition of a processing to a form displayable on the sink device, and processes the acquired content into a form displayable on the sink device, the acquisition, evaluation, and processing being user-transparent.

65. A method for managing content comprising:
determining format or formats of a plurality of content sources; and
processing the format or formats to a format compatible with a sink device without user interaction.

66. A method for managing content on a user device comprising:
acquiring use and navigation information from one or more sources in at least one format;
deriving a combination of the use and navigation information;
incorporating the information combination into a menuing display of the user device; and
accessing content from the at least one source based on the information combination without requiring any additional information from the user.

67. A method for automatically accessing media content comprising:
interfacing to a plurality of diverse sources supplying media content in multiple formats, the sources and media content being capable of dynamic modification;
organizing the media content according to navigation information derived from relative location of the media and sources;
displaying the media content organization as a user interface for selecting a media content element for access; and
accessing a selected media content element.

68. The method according to Claim 67 further comprising:
dynamically configuring a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.

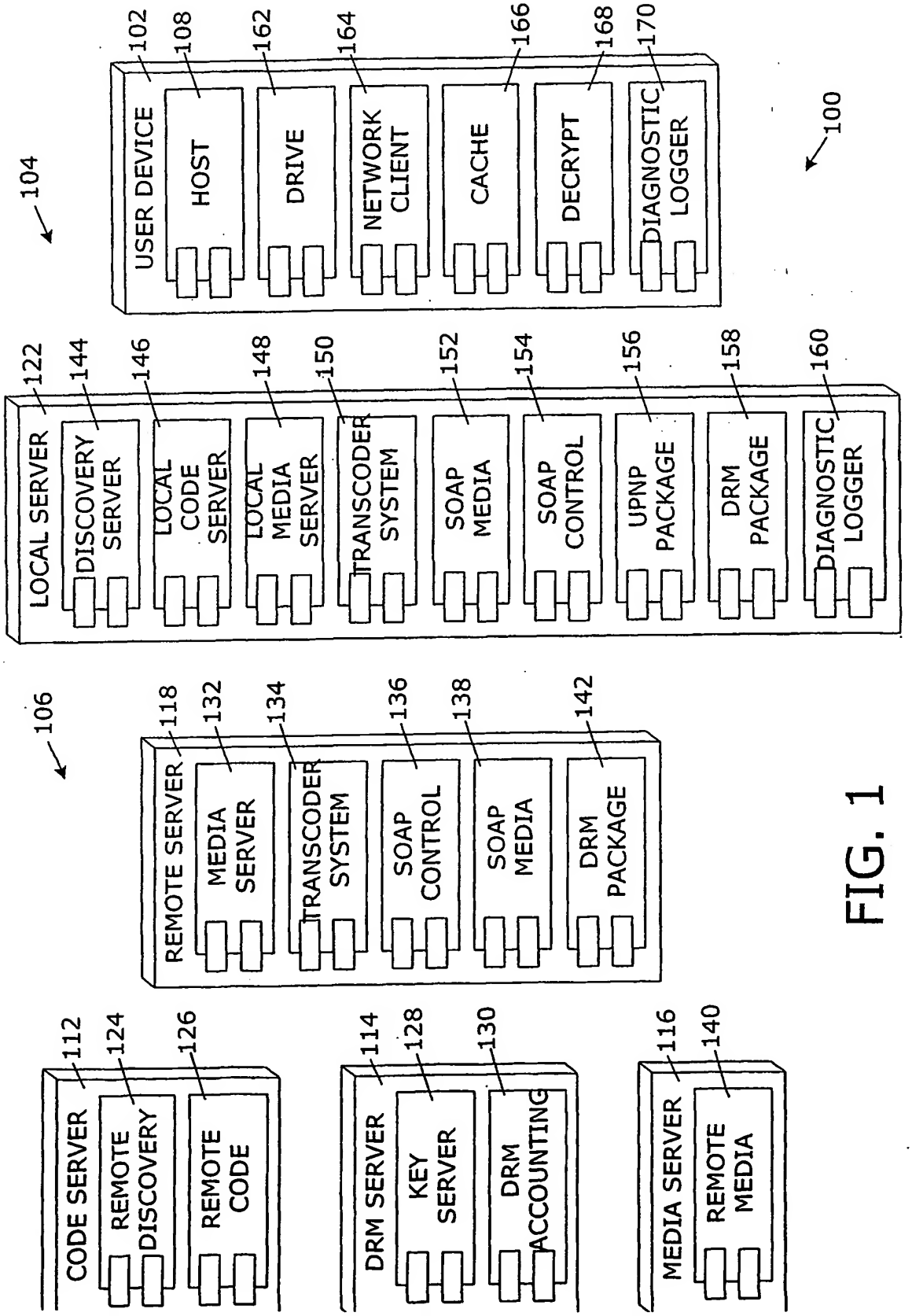
100
102
USER DEVICE
104
108
HOST
162
DRIVE
164
NETWORK CLIENT
166
CACHE
168
DECRYPT
170
DIAGNOSTIC LOGGER
122
LOCAL SERVER
144
DISCOVERY SERVER
146
LOCAL CODE SERVER
148
LOCAL MEDIA SERVER
150
TRANSCODER SYSTEM
152
SOAP MEDIA
154
SOAP CONTROL
156
UPNP PACKAGE
158
DRM PACKAGE
160
DIAGNOSTIC LOGGER
106
118
REMOTE SERVER
132
MEDIA SERVER
134
TRANSCODER SYSTEM
136
SOAP CONTROL
138
SOAP MEDIA
142
DRM PACKAGE
112
CODE SERVER
124
REMOTE DISCOVERY
126
REMOTE CODE
114
DRM SERVER
128
KEY SERVER
130
DRM ACCOUNTING
116
MEDIA SERVER
140
REMOTE MEDIA

FIG. 1

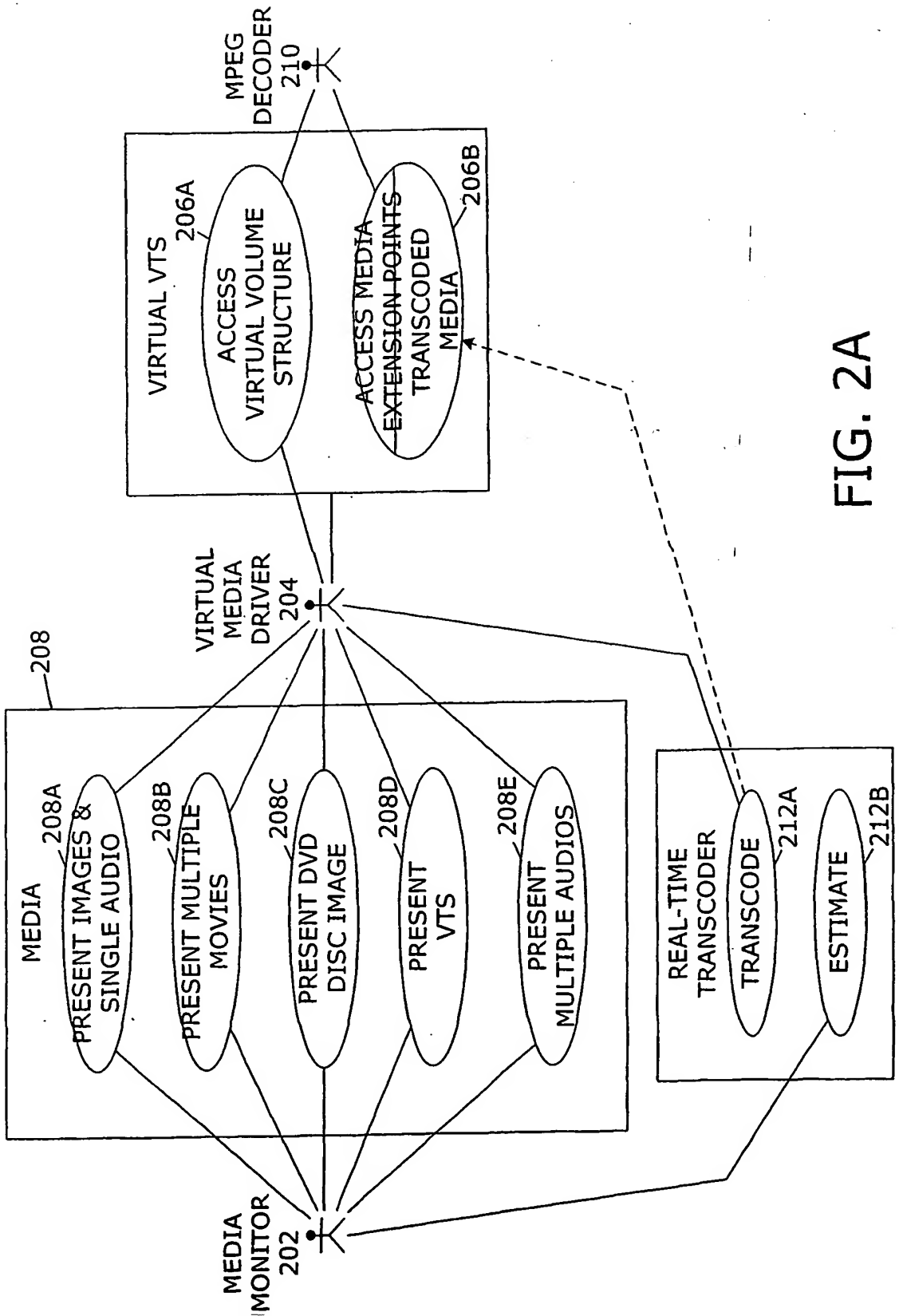
MEDIA MONITOR 202
MEDIA 208
PRESENT IMAGES & SINGLE AUDIO 208A
PRESENT MULTIPLE MOVIES 208B
PRESENT DVD DISC IMAGE 208C
PRESENT VTS 208D
PRESENT MULTIPLE AUDIOS 208E
VIRTUAL MEDIA DRIVER 204
VIRTUAL VTS 206A
ACCESS VIRTUAL VOLUME STRUCTURE
ACCESS MEDIA EXTENSION POINTS TRANSCODED MEDIA 206B
MPEG DECODER 210
REAL-TIME TRANSCODER
TRANSCODE 212A
ESTIMATE 212B

FIG. 2A

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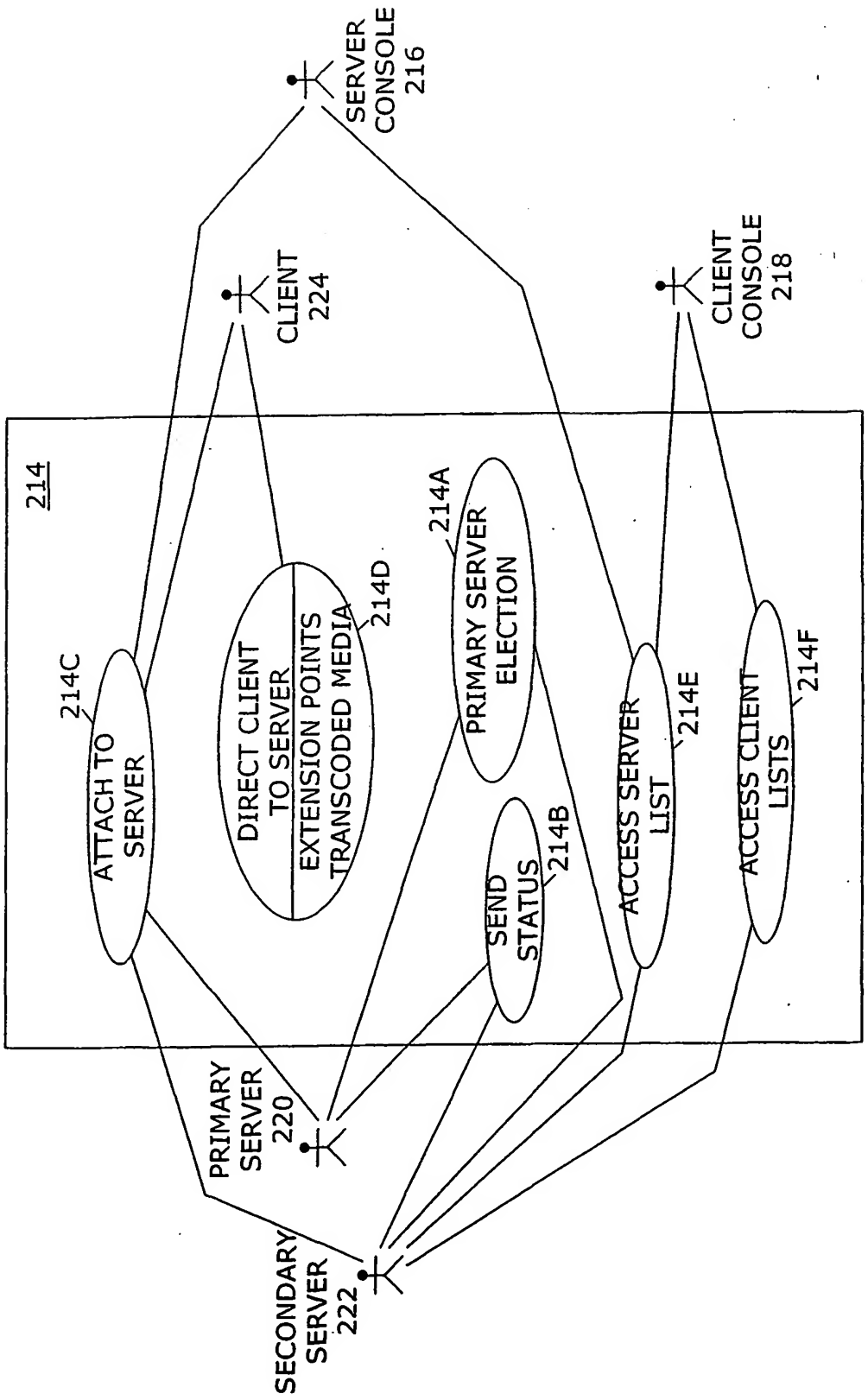
SERVER CONSOLE 216
CLIENT 224
CLIENT CONSOLE 218
214
214C
ATTACH TO SERVER
DIRECT CLIENT TO SERVER
EXTENSION POINTS
TRANSCODED MEDIA
214D
214A
PRIMARY SERVER ELECTION
SEND STATUS
214B
ACCESS SERVER LIST
214E
ACCESS CLIENT LISTS
214F
PRIMARY SERVER 220
SECONDARY SERVER 222

FIG. 2B

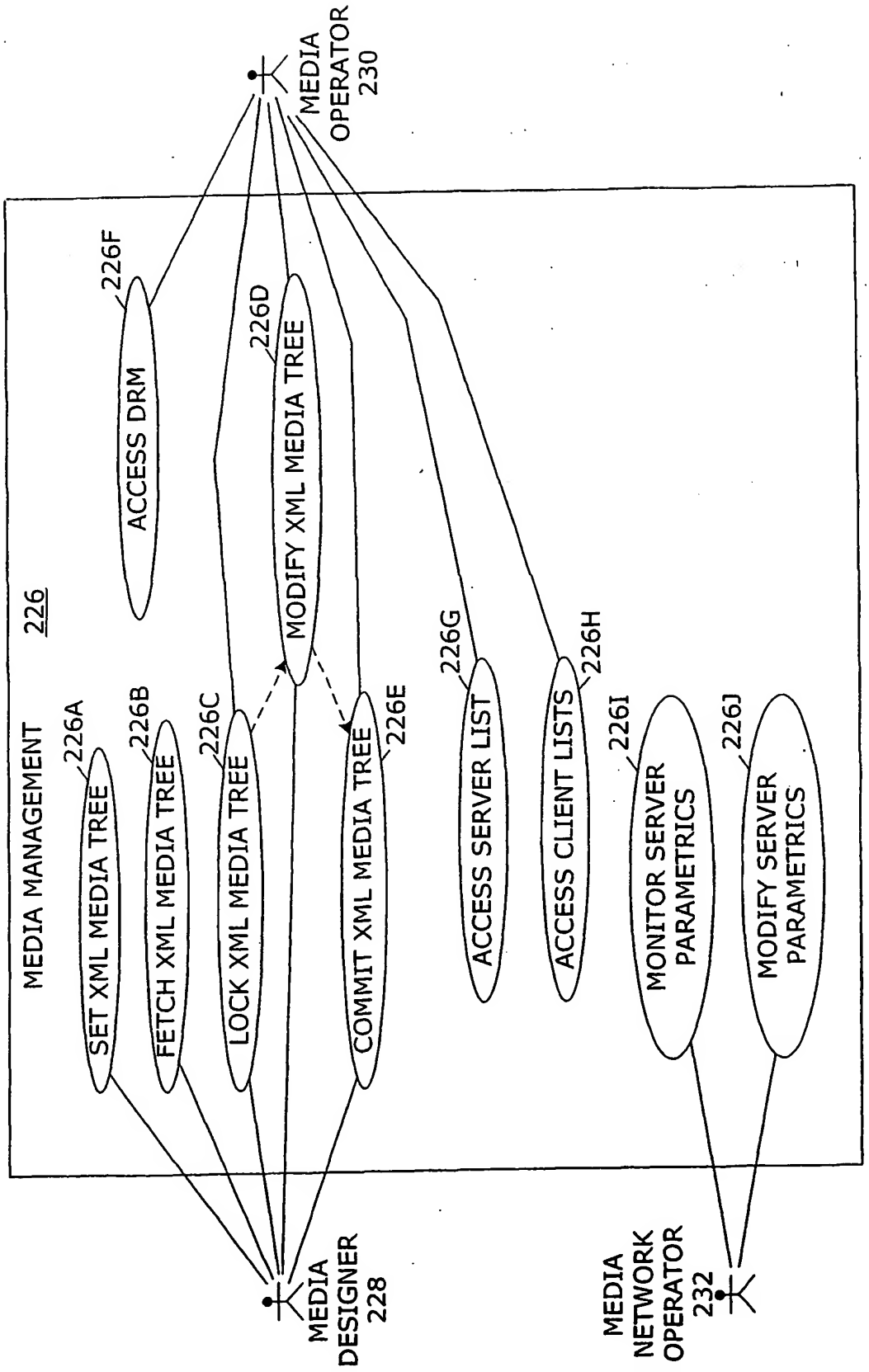
MEDIA MANAGEMENT
226
SET XML MEDIA TREE
226A
FETCH XML MEDIA TREE
226B
LOCK XML MEDIA TREE
226C
MODIFY XML MEDIA TREE
226D
COMMIT XML MEDIA TREE
226E
ACCESS DRM
226F
ACCESS SERVER LIST
226G
ACCESS CLIENT LISTS
226H
MONITOR SERVER PARAMETRICS
226I
MODIFY SERVER PARAMETRICS
226J
MEDIA OPERATOR 230
MEDIA DESIGNER 228
MEDIA NETWORK OPERATOR 232

FIG. 2C

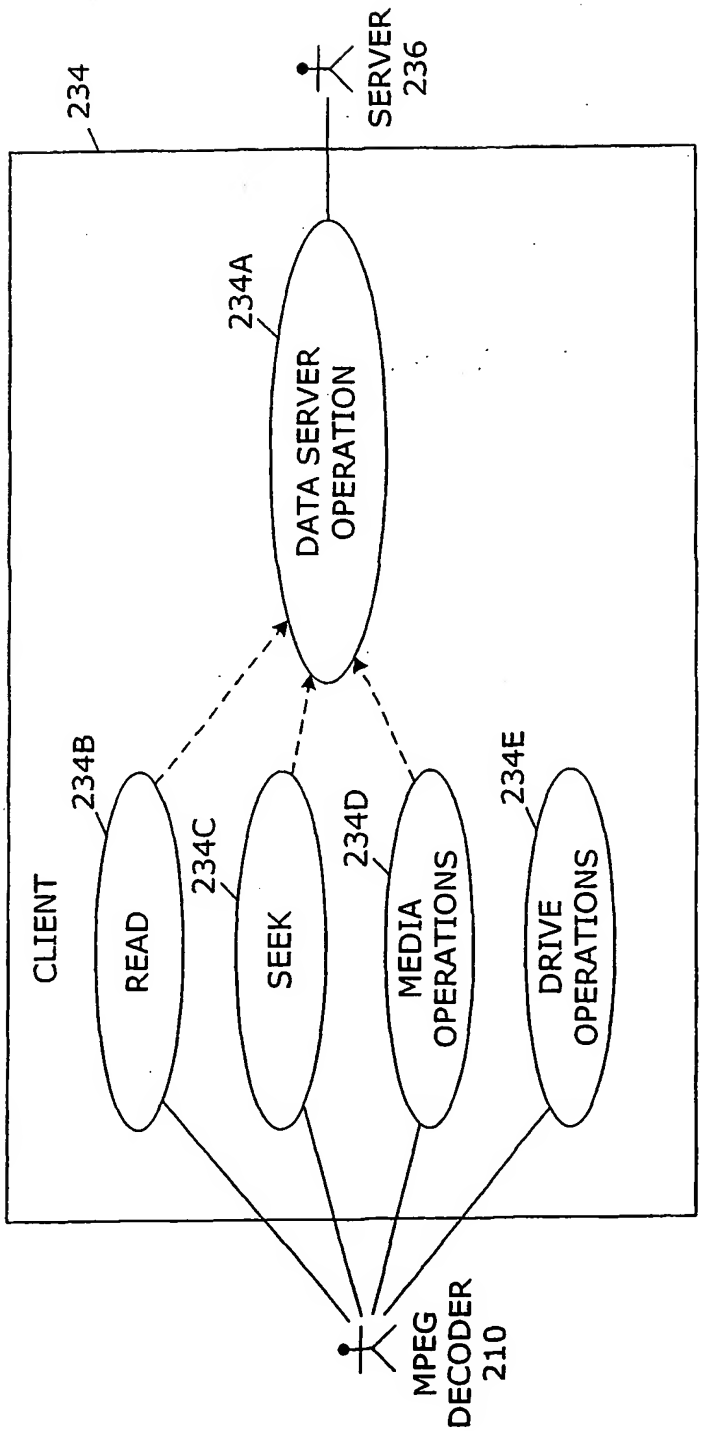
234
SERVER
236
234A
DATA SERVER
OPERATION
CLIENT
234B
READ
234C
SEEK
234D
MEDIA
OPERATIONS
234E
DRIVE
OPERATIONS
MPEG
DECODER
210

FIG. 2D

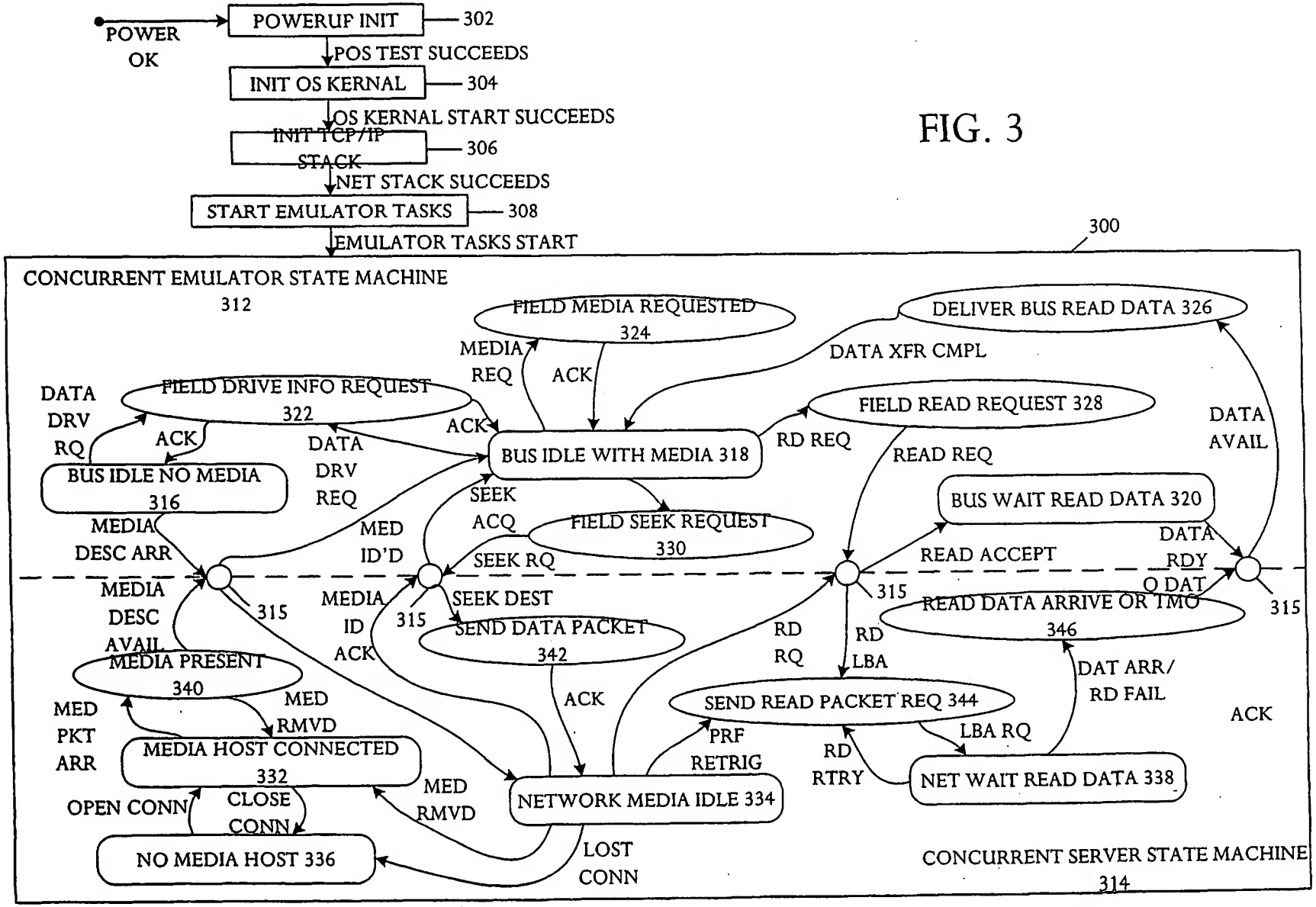
POWER OK
POWERUP INIT
302
POS TEST SUCCEEDS
INIT OS KERNAL
304
OS KERNAL START SUCCEEDS
INIT TCP/IP STACK
306
NET STACK SUCCEEDS
START EMULATOR TASKS
308
EMULATOR TASKS START
300
CONCURRENT EMULATOR STATE MACHINE
312
FIELD MEDIA REQUESTED 324
DELIVER BUS READ DATA 326
DATA XFR CMPL
MEDIA REQ
ACK
DATA DRV RQ
FIELD DRIVE INFO REQUEST 322
ACK
DATA DRV REQ
ACK
BUS IDLE WITH MEDIA 318
RD REQ
FIELD READ REQUEST 328
READ REQ
DATA AVAIL
BUS IDLE NO MEDIA 316
SEEK ACQ
FIELD SEEK REQUEST 330
BUS WAIT READ DATA 320
MEDIA DESC ARR
MED ID'D
SEEK RQ
READ ACCEPT
DATA RDY Q DAT
315
MEDIA DESC AVAIL
MEDIA ID ACK
315
SEEK DEST
SEND DATA PACKET 342
315
READ DATA ARRIVE OR TMO 346
315
RD RQ
RD LBA
MEDIA PRESENT 340
MED RMVD
ACK
SEND READ PACKET REQ 344
DAT ARR/ RD FAIL
MED PKT ARR
MEDIA HOST CONNECTED 332
PRF RETRIG
LBA RQ
ACK
RD RTRY
NET WAIT READ DATA 338
OPEN CONN
CLOSE CONN
MED RMVD
NETWORK MEDIA IDLE 334
NO MEDIA HOST 336
LOST CONN
CONCURRENT SERVER STATE MACHINE
314

FIG. 3

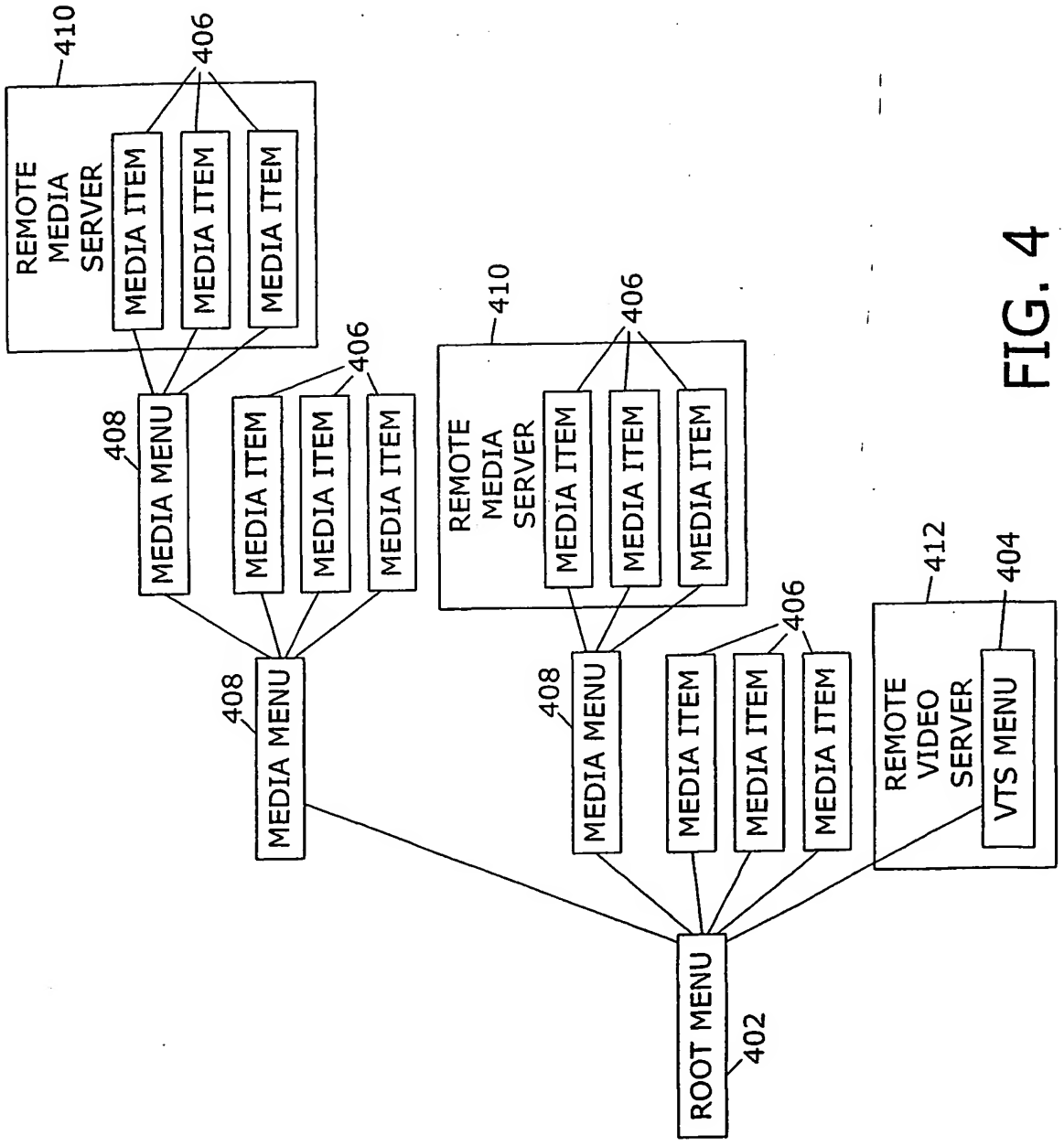
ROOT MENU
402
MEDIA MENU
408
MEDIA ITEM
406
REMOTE MEDIA SERVER
410
REMOTE VIDEO SERVER
412
VTS MENU
404

FIG. 4

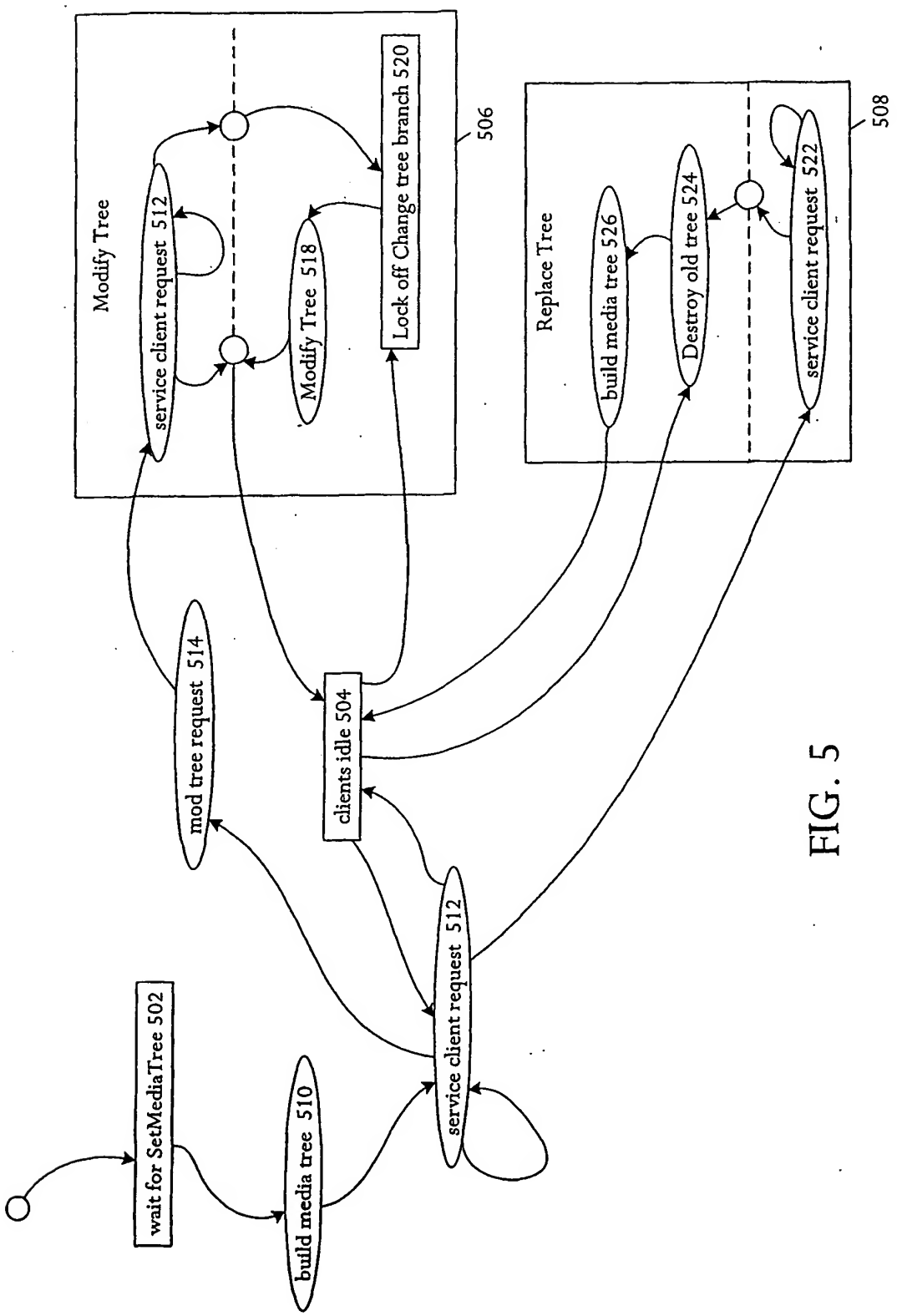
wait for SetMediaTree 502
build media tree 510
service client request 512
mod tree request 514
clients idle 504
Modify Tree
service client request 512
Modify Tree 518
Lock off Change tree branch 520
506
Replace Tree
build media tree 526
Destroy old tree 524
service client request 522
508

FIG. 5

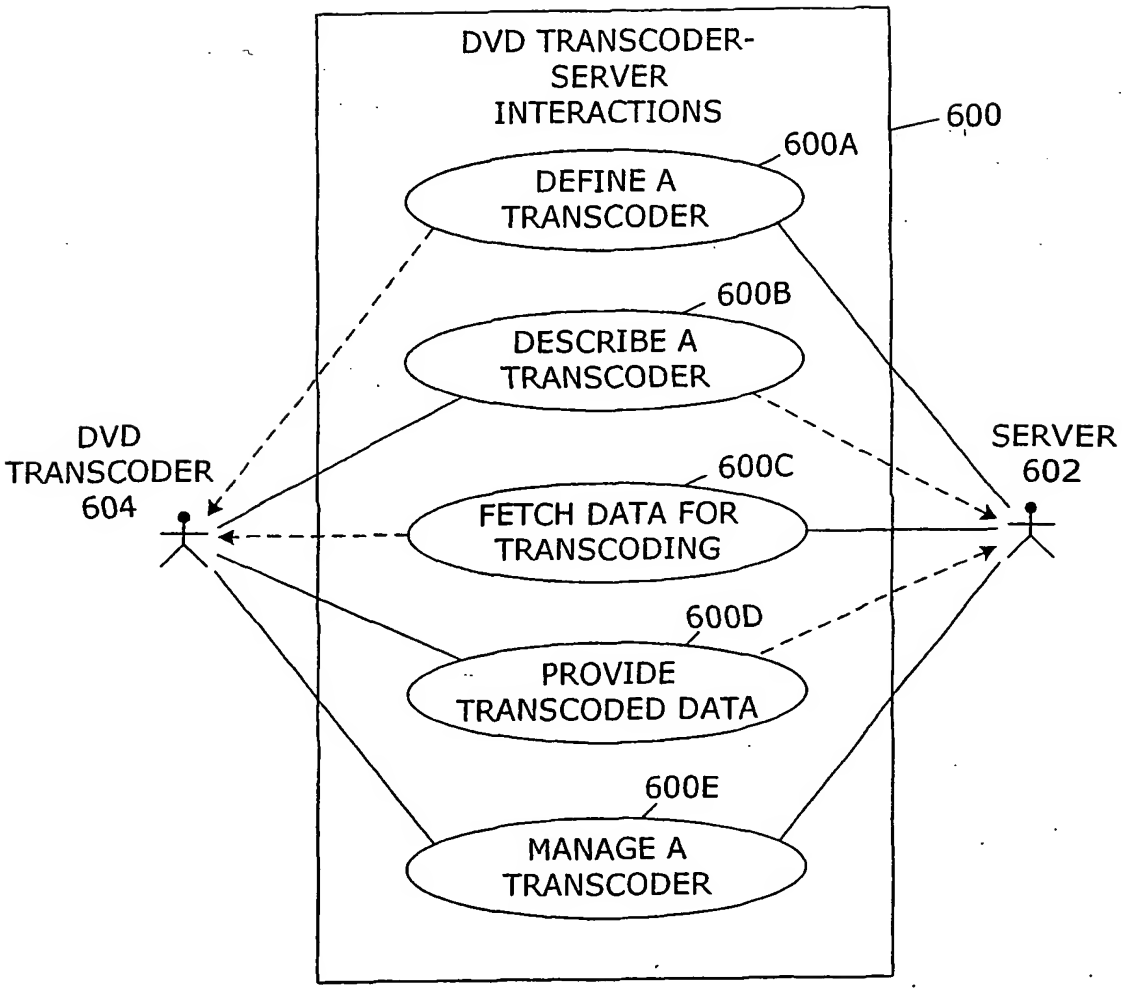
DVD TRANSCODER-SERVER INTERACTIONS
600
600A
DEFINE A TRANSCODER
600B
DESCRIBE A TRANSCODER
600C
FETCH DATA FOR TRANSCODING
600D
PROVIDE TRANSCODED DATA
600E
MANAGE A TRANSCODER
DVD TRANSCODER 604
SERVER 602

FIG. 6

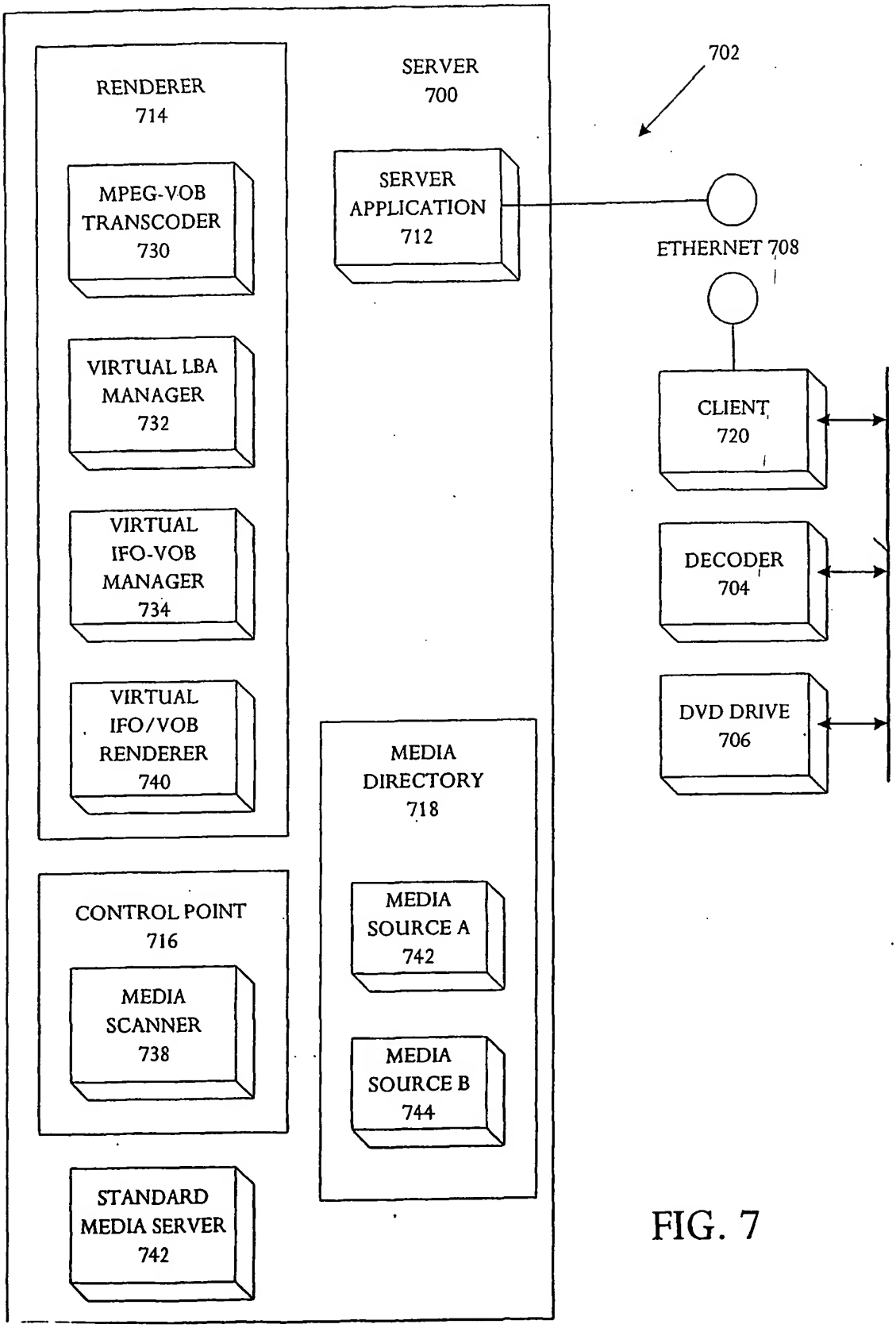
SERVER
700
RENDERER
714
MPEG-VOB
TRANSCODER
730
VIRTUAL LBA
MANAGER
732
VIRTUAL
IFO-VOB
MANAGER
734
VIRTUAL
IFO/VOB
RENDERER
740
CONTROL POINT
716
MEDIA
SCANNER
738
STANDARD
MEDIA SERVER
742
SERVER
APPLICATION
712
MEDIA
DIRECTORY
718
MEDIA
SOURCE A
742
MEDIA
SOURCE B
744
702
ETHERNET 708
CLIENT
720
DECODER
704
DVD DRIVE
706

FIG. 7

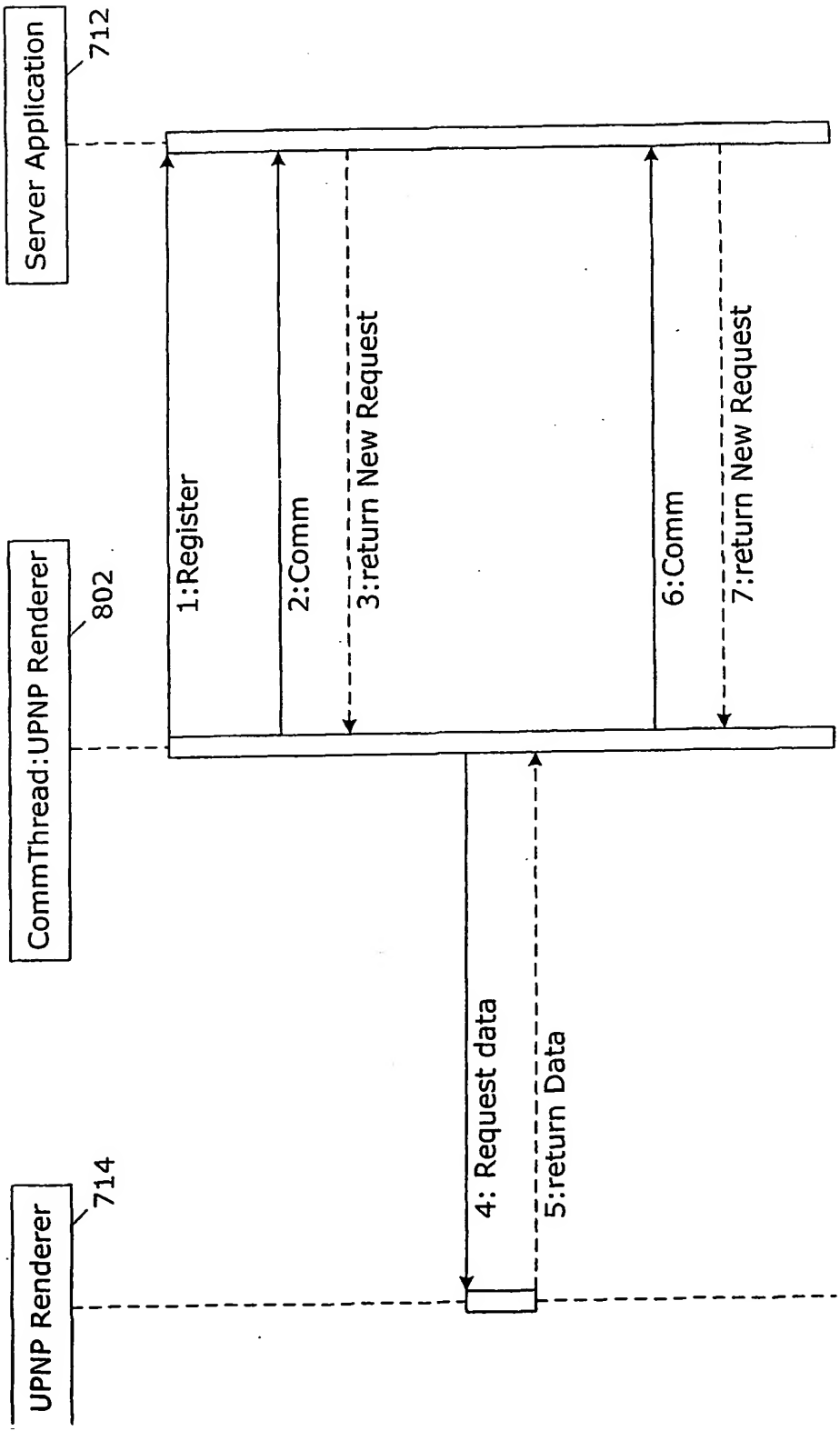
Server Application
712
CommThread:UPNP Renderer
802
UPNP Renderer
714
1:Register
2:Comm
3:return New Request
4: Request data
5:return Data
6:Comm
7:return New Request

FIG. 8A

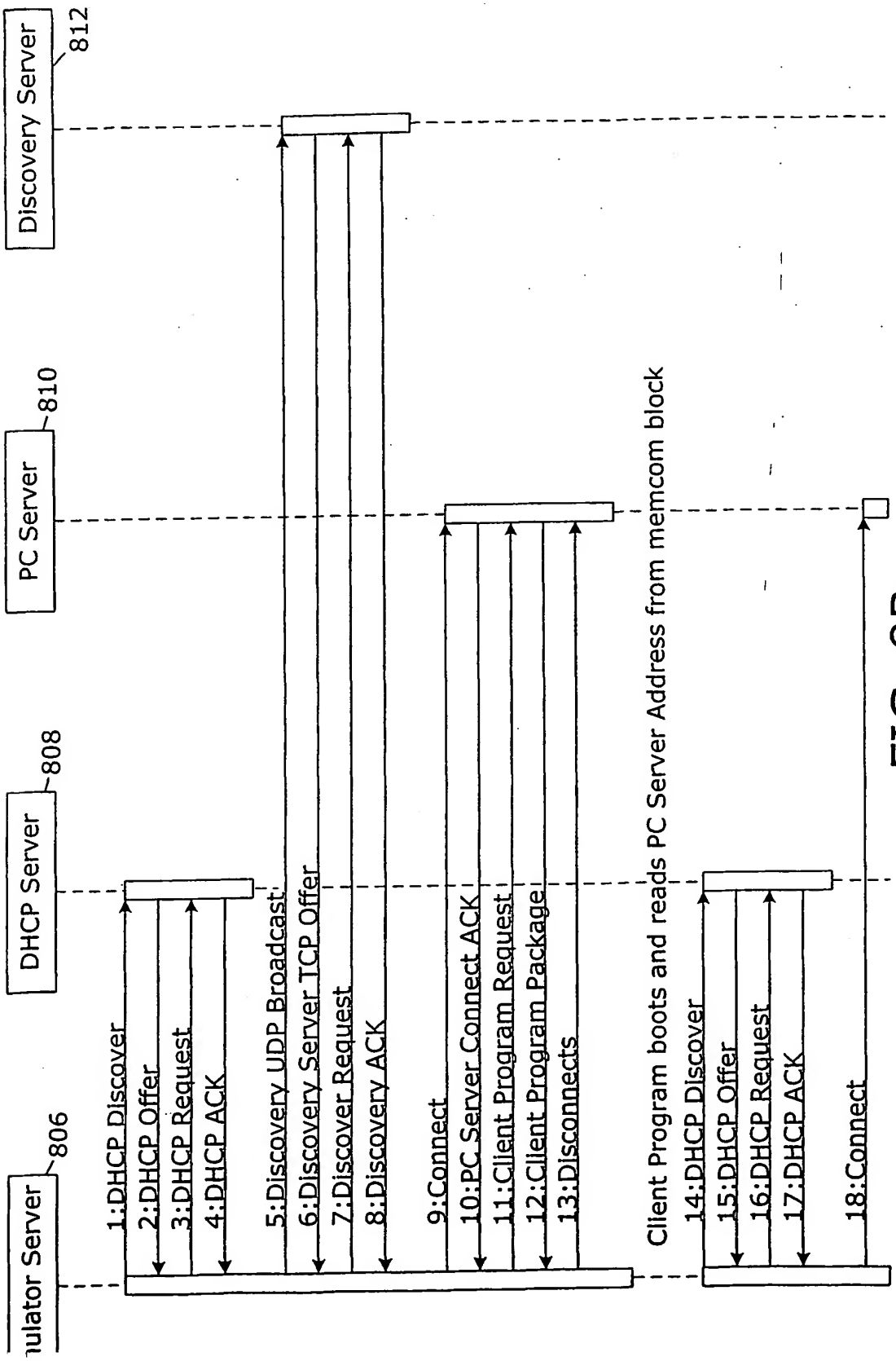
Discovery Server
812
PC Server
810
DHCP Server
808
ulator Server
806
1:DHCP Discover
2:DHCP Offer
3:DHCP Request
4:DHCP ACK
5:Discovery UDP Broadcast
6:Discovery Server TCP Offer
7:Discover Request
8:Discovery ACK
9:Connect
10:PC Server Connect ACK
11:Client Program Request
12:Client Program Package
13:Disconnects
Client Program boots and reads PC Server Address from memcom block
14:DHCP Discover
15:DHCP Offer
16:DHCP Request
17:DHCP ACK
18:Connect

FIG. 8B

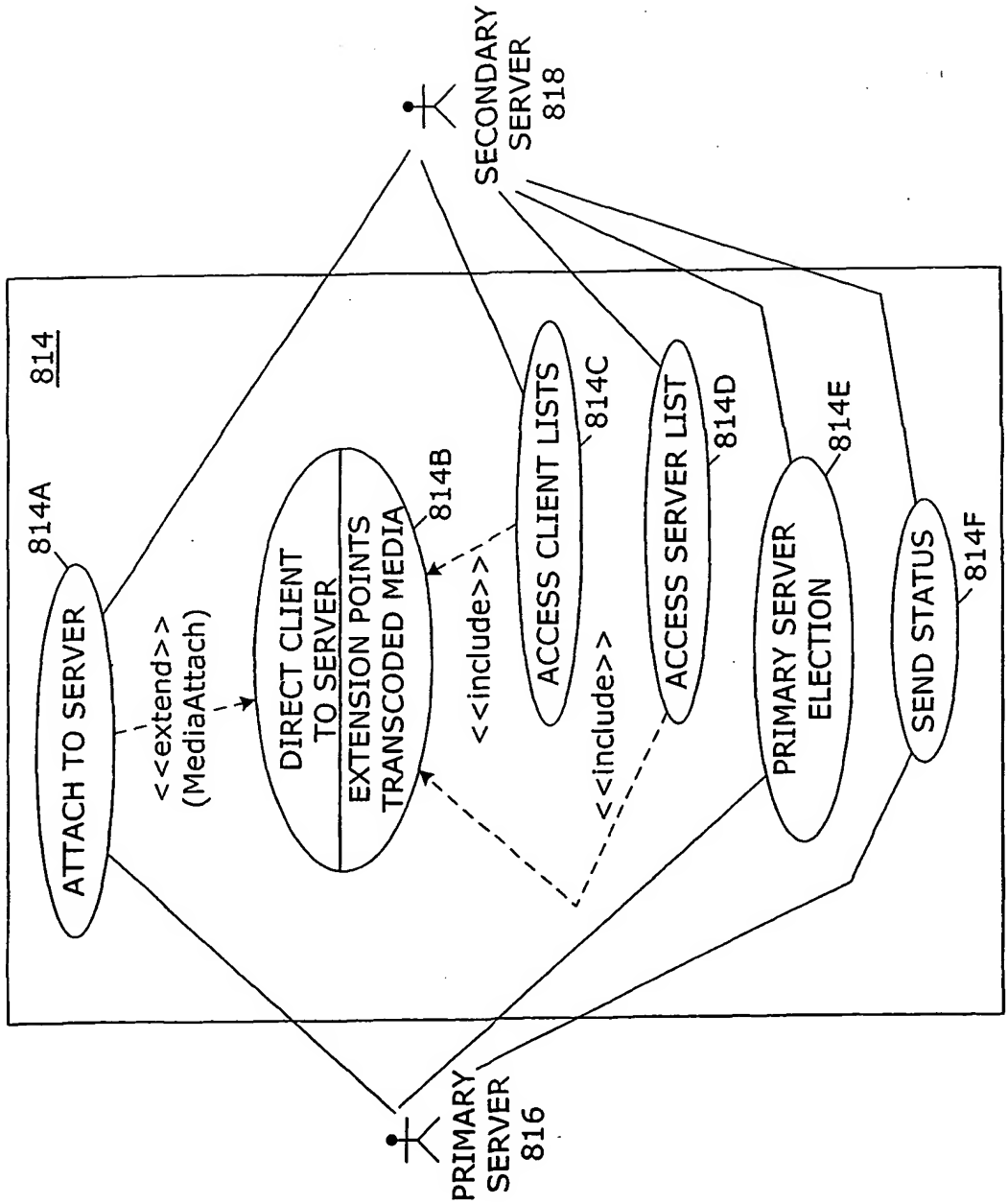
814
814A
ATTACH TO SERVER
<<extend>>
(MediaAttach)
DIRECT CLIENT
TO SERVER
EXTENSION POINTS
TRANSCODED MEDIA
814B
<<include>>
ACCESS CLIENT LISTS
814C
<<include>>
ACCESS SERVER LIST
814D
PRIMARY SERVER
ELECTION
814E
SEND STATUS
814F
SECONDARY
SERVER
818
PRIMARY
SERVER
816

FIG. 8C

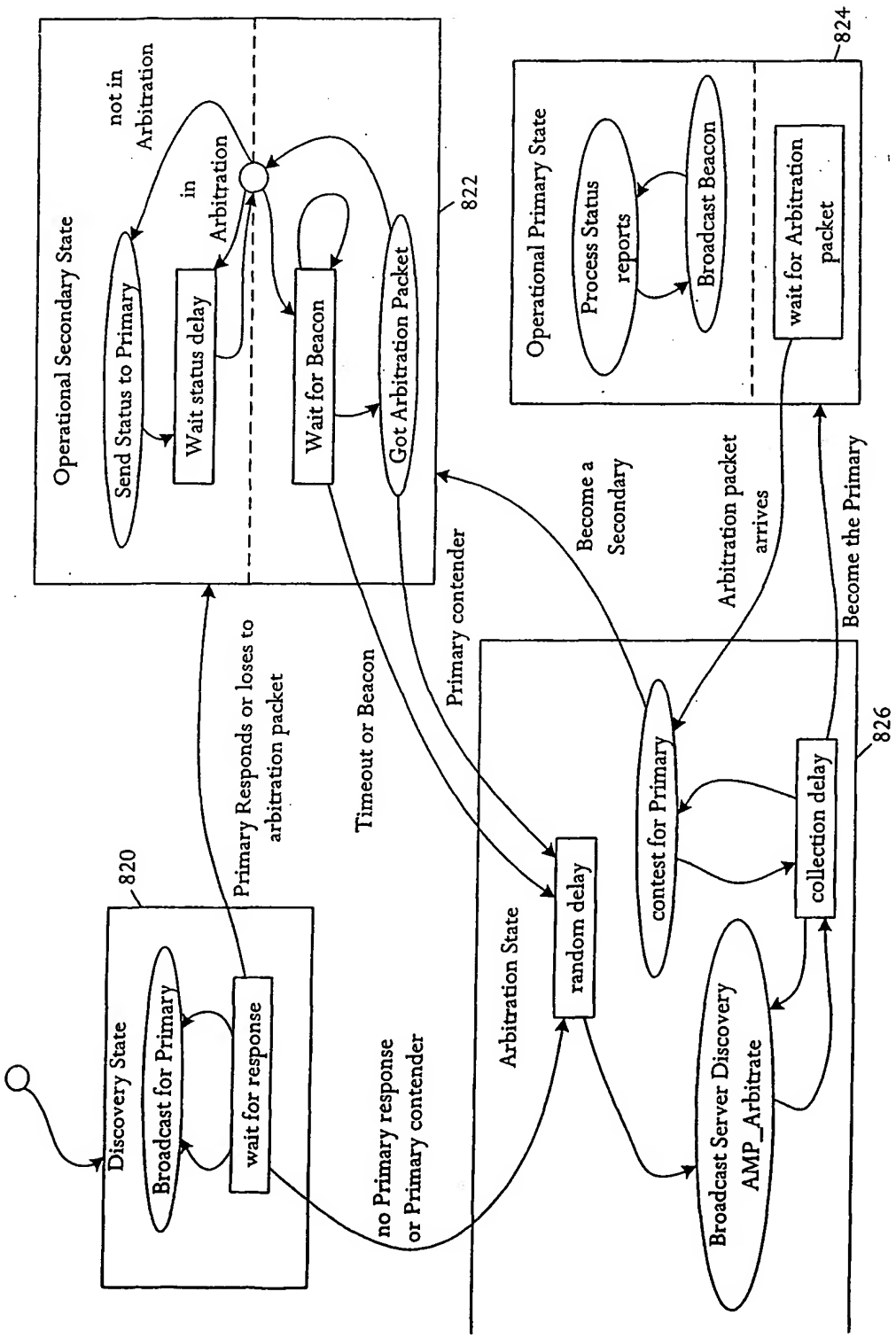
Operational Secondary State
not in Arbitration
in Arbitration
Send Status to Primary
Wait status delay
Wait for Beacon
Got Arbitration Packet
822
Operational Primary State
Process Status reports
Broadcast Beacon
wait for Arbitration packet
824
Become a Secondary
Arbitration packet arrives
Become the Primary
Primary contender
Timeout or Beacon
Primary Responds or loses to arbitration packet
820
Discovery State
Broadcast for Primary
wait for response
no Primary response or Primary contender
Arbitration State
random delay
contest for Primary
collection delay
826
Broadcast Server Discovery AMP_Arbitrate

FIG. 8D

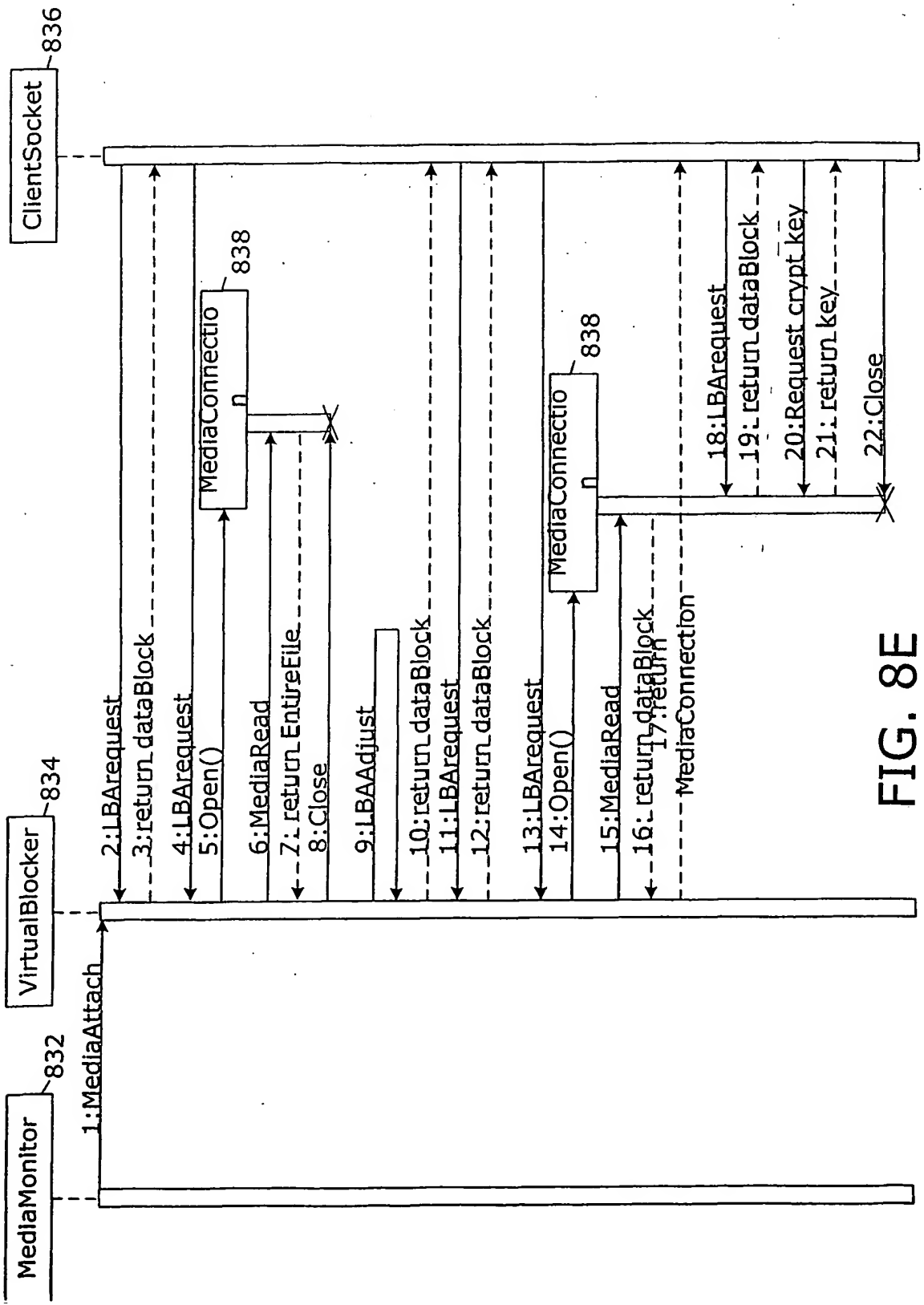
MediaMonitor
832
VirtualBlocker
834
ClientSocket
836
1:MediaAttach
2:LBArequest
3:return dataBlock
4:LBArequest
5:Open()
MediaConnectio
n
838
6:MediaRead
7: return EntireFile
8:Close
9:LBAAdjust
10:return dataBlock
11:LBArequest
12:return dataBlock
13:LBArequest
14:Open()
MediaConnectio
n
838
15:MediaRead
16: return dataBlock
17:return
MediaConnection
18:LBArequest
19: return dataBlock
20:Request crypt key
21: return key
22:Close

FIG. 8E

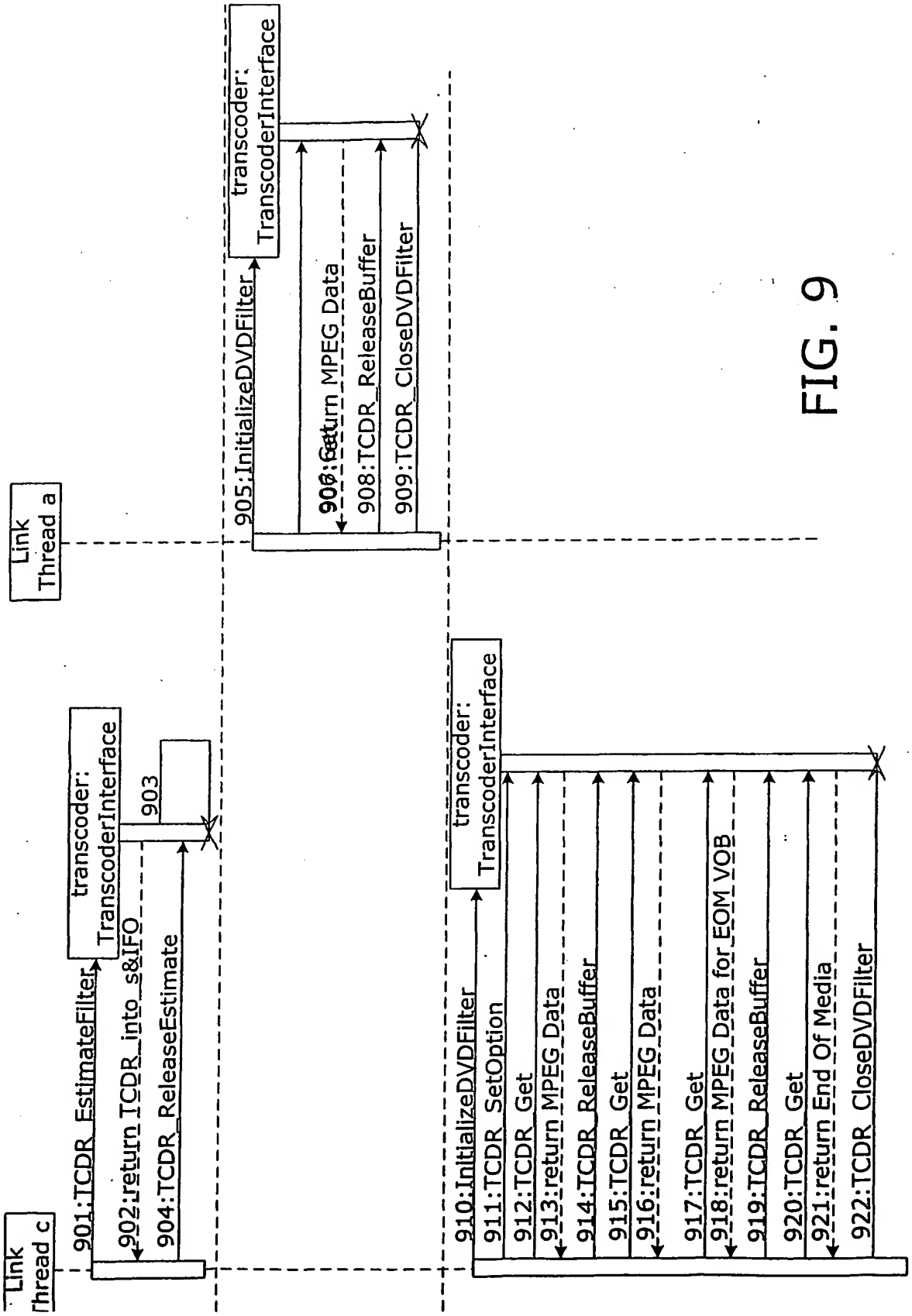
Link Thread a
Link Thread c
transcoder: TranscoderInterface
transcoder: TranscoderInterface
901:TCDR_EstimateFilter
902:return TCDR_into_s&IFO
903
904:TCDR_ReleaseEstimate
905:InitializeDVDFilter
906:Get
907:return MPEG Data
908:TCDR_ReleaseBuffer
909:TCDR_CloseDVDFilter
910:InitializeDVDFilter
911:TCDR_SetOption
912:TCDR_Get
913:return MPEG Data
914:TCDR_ReleaseBuffer
915:TCDR_Get
916:return MPEG Data
917:TCDR_Get
918:return MPEG Data for EOM VOB
919:TCDR_ReleaseBuffer
920:TCDR_Get
921:return End Of Media
922:TCDR_CloseDVDFilter

FIG. 9

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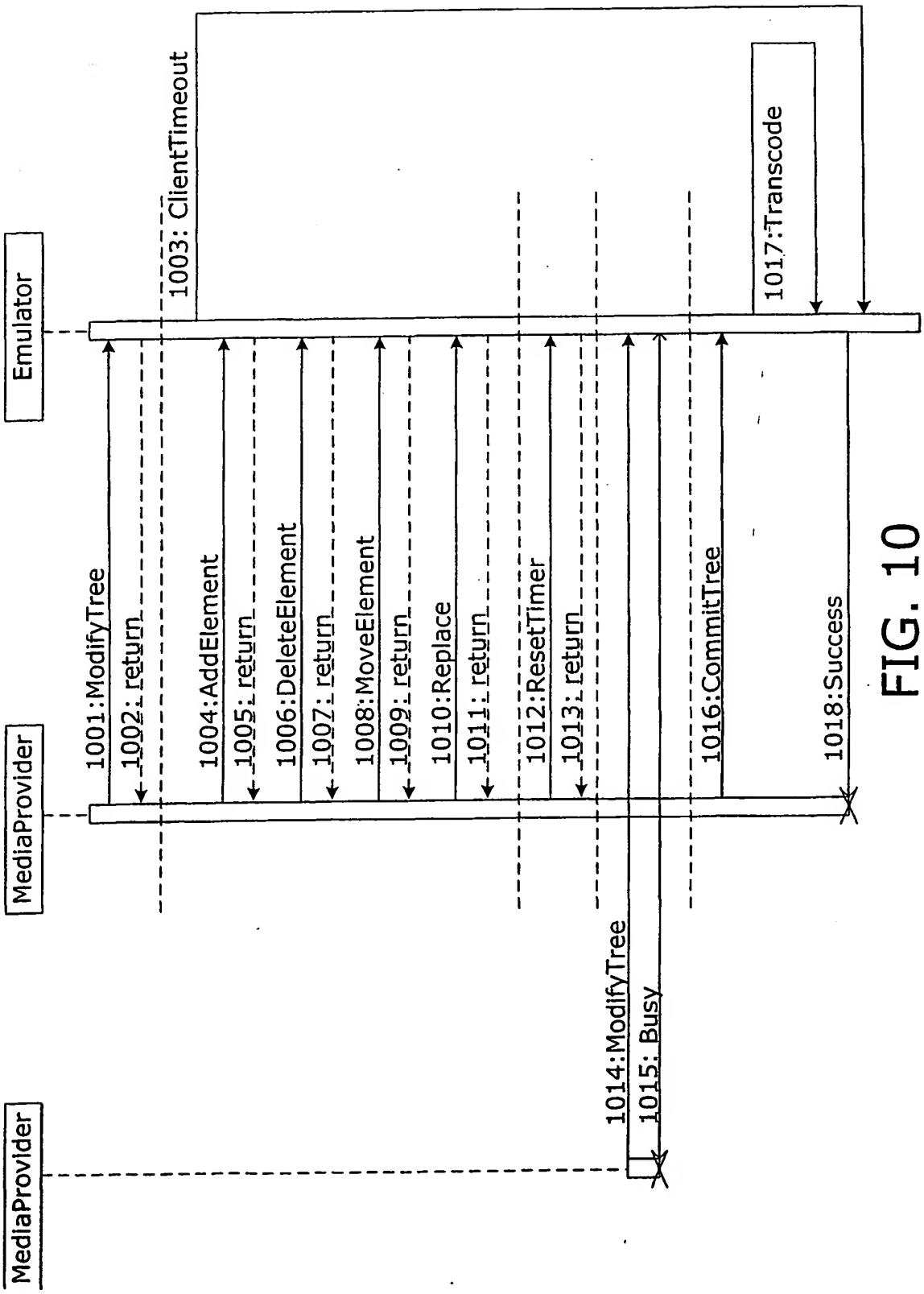
Emulator
MediaProvider
MediaProvider
1001:ModifyTree
1002: return
1003: ClientTimeout
1004:AddElement
1005: return
1006:DeleteElement
1007: return
1008:MoveElement
1009: return
1010:Replace
1011: return
1012:ResetTimer
1013: return
1014:ModifyTree
1015: Busy
1016:CommitTree
1017:Transcode
1018:Success

FIG. 10

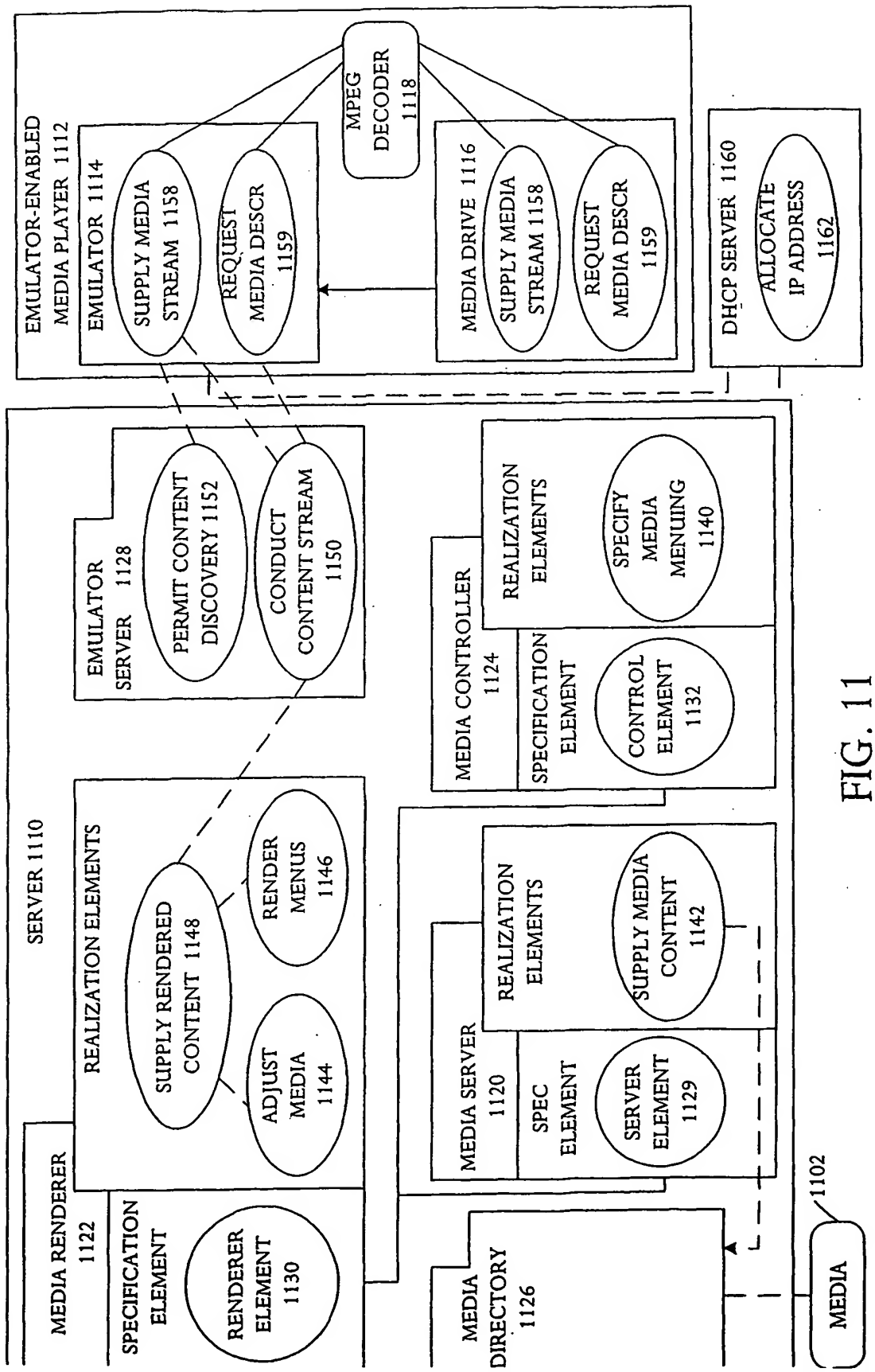
700
EMULATOR-ENABLED MEDIA PLAYER 1112
EMULATOR 1114
SUPPLY MEDIA STREAM 1158
REQUEST MEDIA DESCR 1159
MPEG DECODER 1118
MEDIA DRIVE 1116
SUPPLY MEDIA STREAM 1158
REQUEST MEDIA DESCR 1159
DHCP SERVER 1160
ALLOCATE IP ADDRESS 1162
SERVER 1110
EMULATOR SERVER 1128
PERMIT CONTENT DISCOVERY 1152
CONDUCT CONTENT STREAM 1150
MEDIA CONTROLLER 1124
REALIZATION ELEMENTS
SPECIFY MEDIA MENUING 1140
SPECIFICATION ELEMENT
CONTROL ELEMENT 1132
MEDIA RENDERER 1122
REALIZATION ELEMENTS
SUPPLY RENDERED CONTENT 1148
RENDER MENUS 1146
ADJUST MEDIA 1144
SPECIFICATION ELEMENT
RENDERER ELEMENT 1130
MEDIA SERVER 1120
REALIZATION ELEMENTS
SUPPLY MEDIA CONTENT 1142
SPEC ELEMENT
SERVER ELEMENT 1129
MEDIA DIRECTORY 1126
1102
MEDIA

FIG. 11

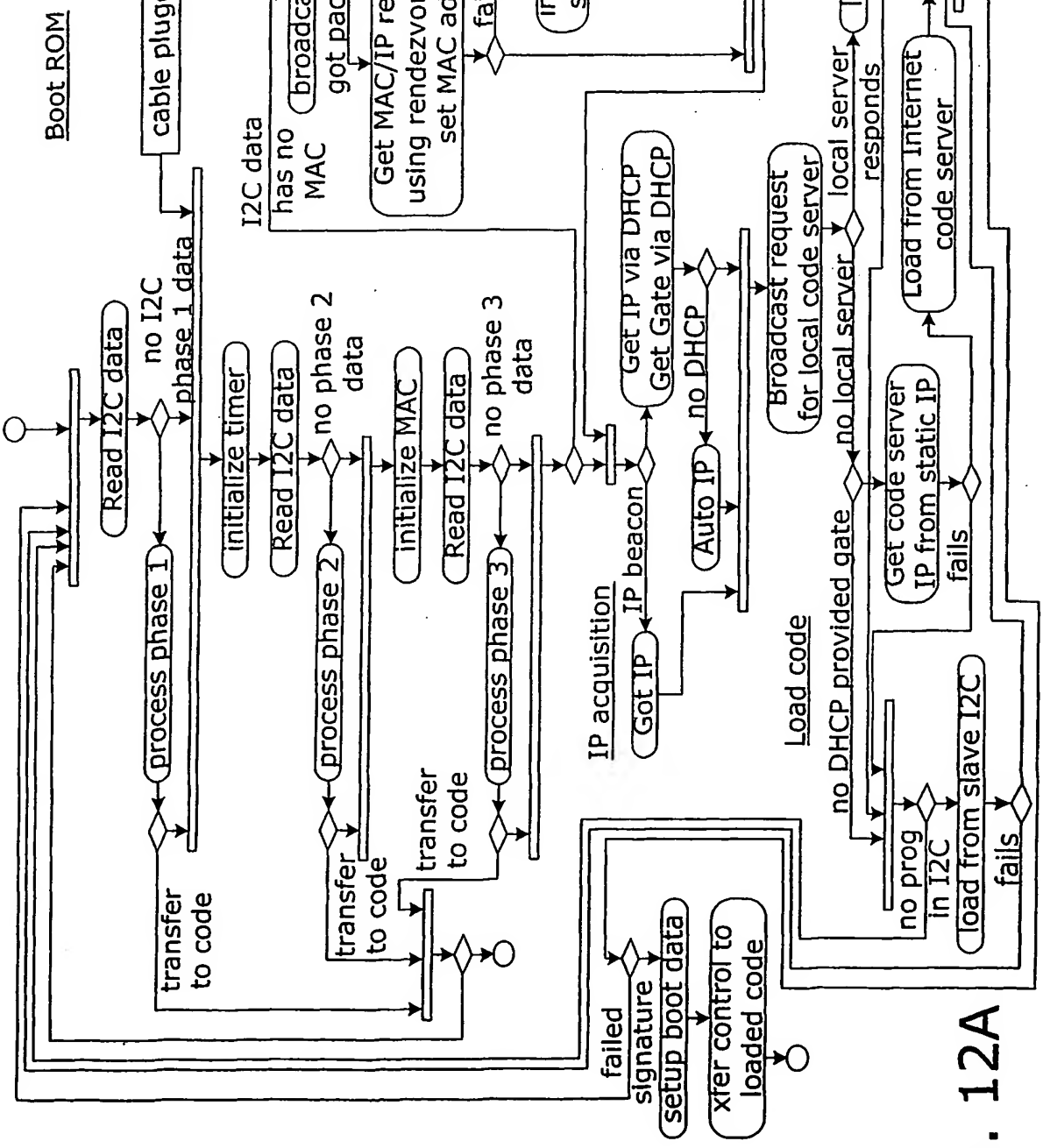
Boot ROM
cable plugged in
Read I2C data
no I2C phase 1 data
process phase 1
transfer to code
initialize timer
Read I2C data
no phase 2 data
process phase 2
transfer to code
initialize MAC
Read I2C data
no phase 3 data
process phase 3
transfer to code
failed signature
setup boot data
xfer control to loaded code
Auto MAC
I2C data has no MAC
broadcast IPMAC request
got packet
Get MAC/IP request using rendezvous addr set MAC addr
fail
increment MAC addr send squeal packet
client responds
set MAC addr
announce MAC nak
IP acquisition
IP beacon
Got IP
Get IP via DHCP Get Gate via DHCP
no DHCP
Auto IP
Load code
Broadcast request for local code server
no local server
local server responds
load from local server
fails
no DHCP provided gate
Get code server IP from static IP
fails
Load from Internet code server
fails
no prog in I2C
load from slave I2C
fails

FIG. 12A

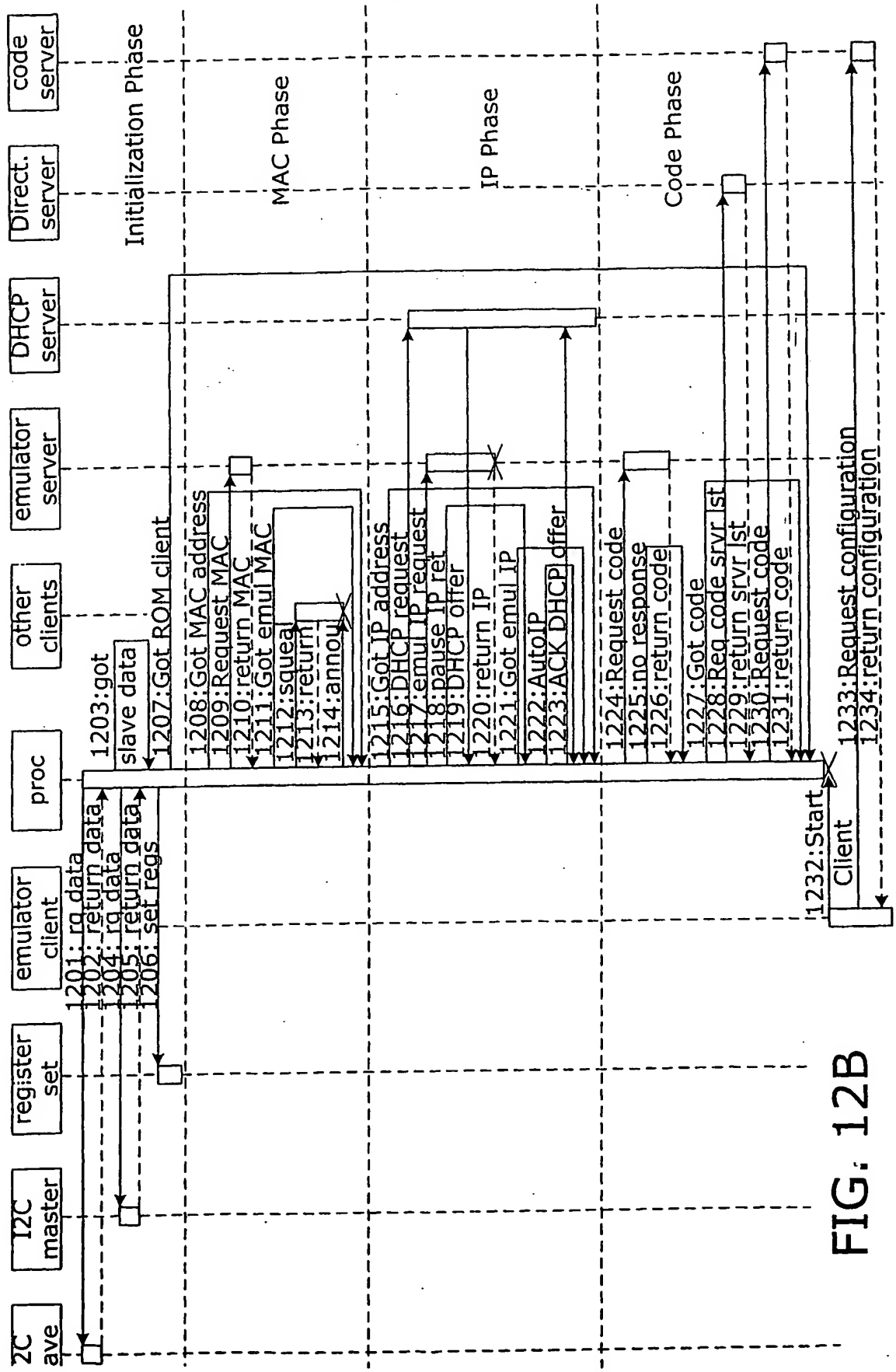
I2C ave
I2C master
register set
emulator client
proc
other clients
emulator server
DHCP server
Direct. server
code server
Initialization Phase
MAC Phase
IP Phase
Code Phase
1201: rq data
1202: return data
1203:got slave data
1204: rq data
1205: return data
1206: set regs
1207:Got ROM client
1208:Got MAC address
1209:Request MAC
1210:return MAC
1211:Got emul MAC
1212:squeal
1213:return
1214:annoy
1215:Got IP address
1216:DHCP request
1217:emul IP request
1218:pause IP ret
1219:DHCP offer
1220:return IP
1221:Got emul IP
1222:AutoIP
1223:ACK DHCP offer
1224:Request code
1225:no response
1226:return code
1227:Got code
1228:Req code srvr lst
1229:return srvr lst
1230:Request code
1231:return code
1232:Start Client
1233:Request configuration
1234:return configuration

FIG. 12B

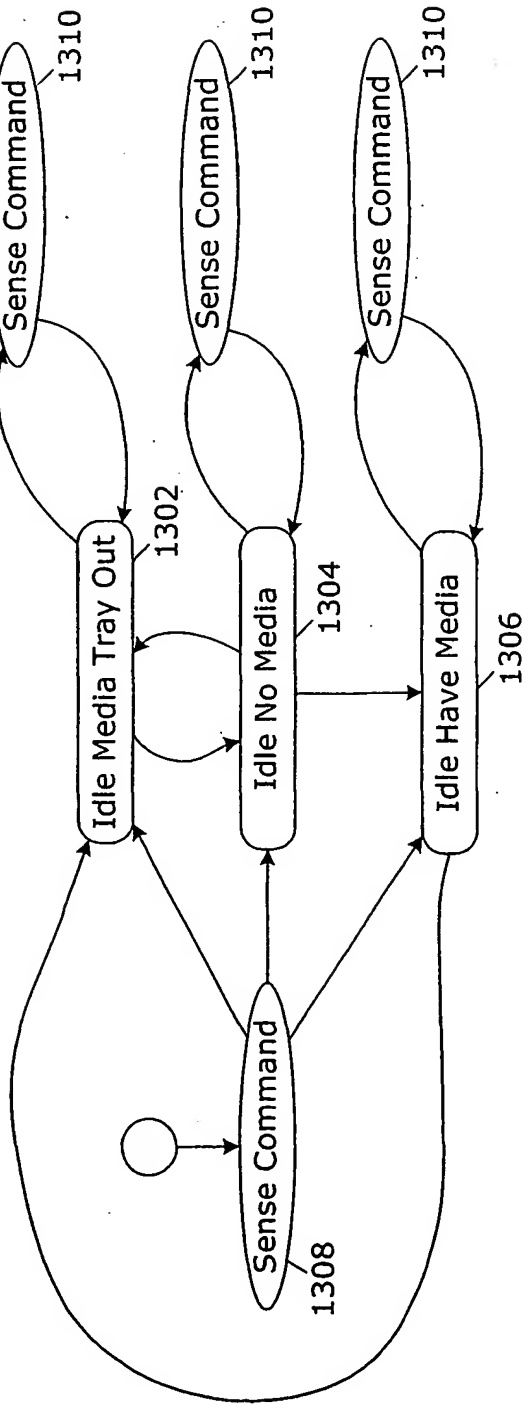
Sense Command
1310
Sense Command
1310
Sense Command
1310
Idle Media Tray Out
1302
Idle No Media
1304
Idle Have Media
1306
Sense Command
1308

FIG. 13A

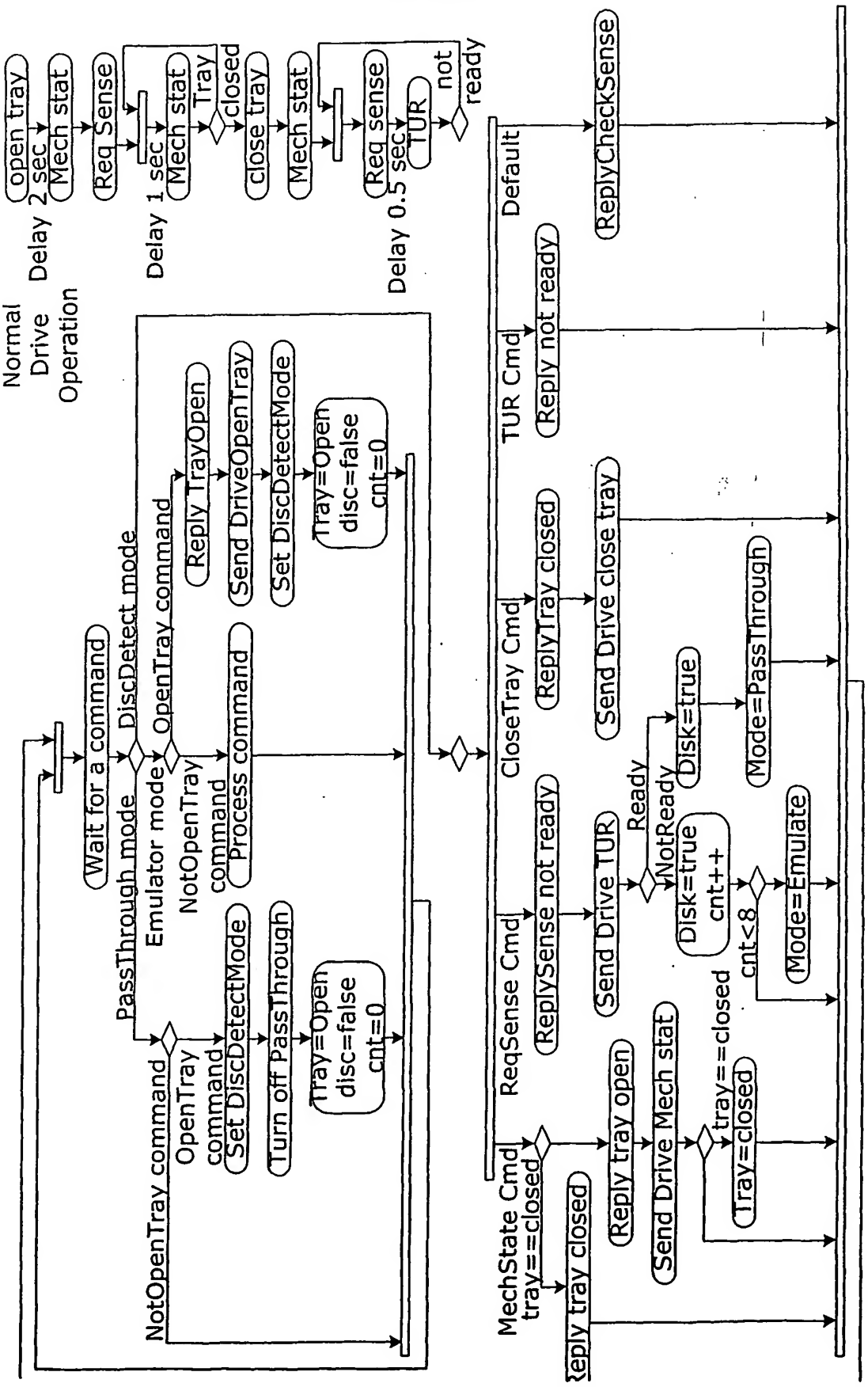
Normal Drive Operation
Delay
open tray
2 sec
Mech stat
Req Sense
Delay 1 sec
Mech stat
Tray
closed
close tray
Mech stat
Delay 0.5 sec
Req sense
TUR
not ready
Wait for a command
PassThrough mode
DiscDetect mode
Emulator mode
OpenTray command
Reply TrayOpen
Send DriveOpenTray
Set DiscDetectMode
Tray=Open
disc=false
cnt=0
NotOpenTray command
OpenTray command
Set DiscDetectMode
Turn off PassThrough
Tray=Open
disc=false
cnt=0
NotOpenTray command
Process command
CloseTray Cmd
ReqSense Cmd
ReplySense not ready
Send Drive TUR
Ready
NotReady
Disk=true
cnt++
cnt<8
Disk=true
Mode=PassThrough
Mode=Emulate
CloseTray Cmd
ReplyTray closed
Send Drive close tray
TUR Cmd
Default
Reply not ready
ReplyCheckSense
MechState Cmd
tray==closed
Reply tray closed
Reply tray open
Send Drive Mech stat
tray==closed
Tray=closed

FIG. 13B

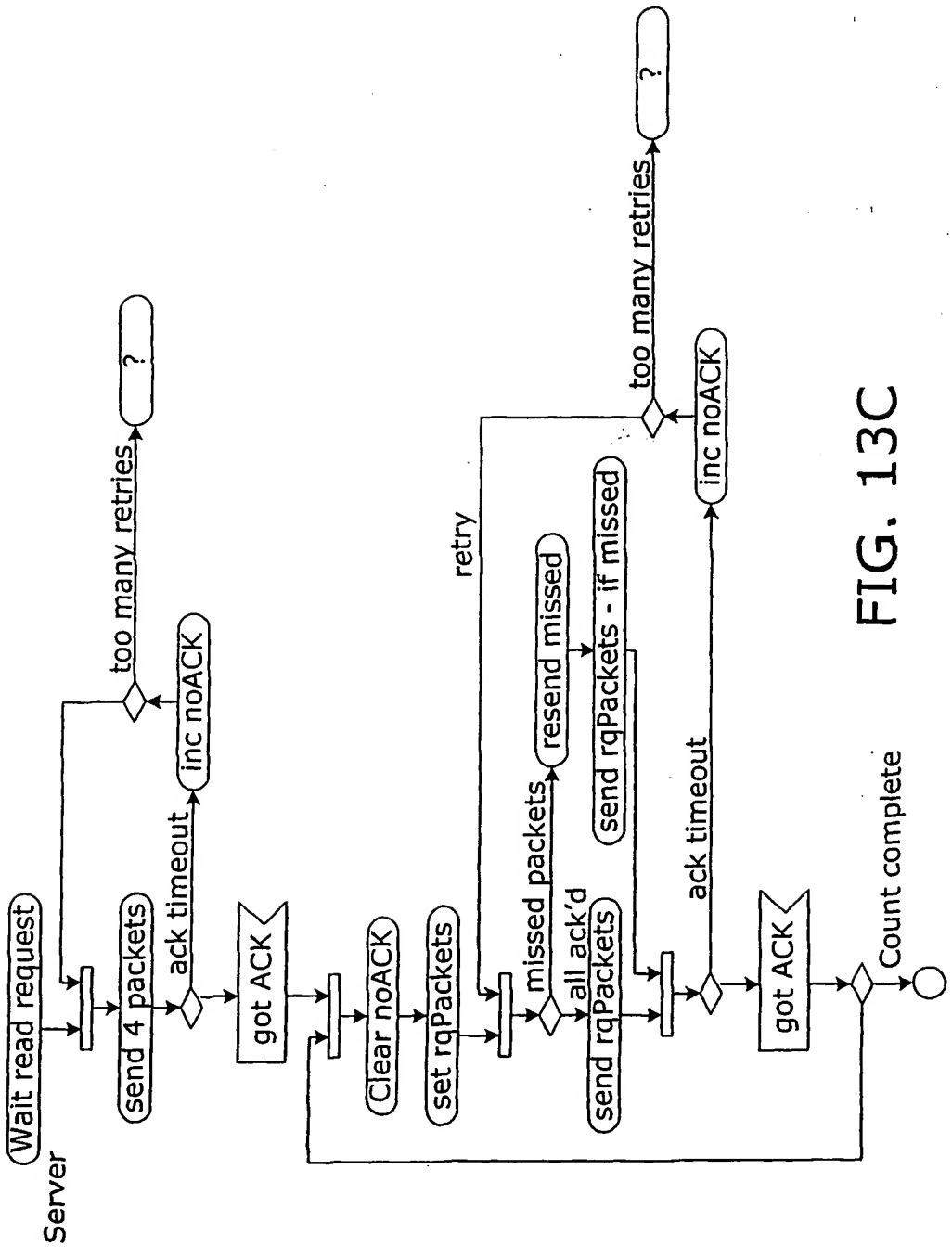
Server
Wait read request
send 4 packets
ack timeout
too many retries
?
inc noACK
got ACK
Clear noACK
set rqPackets
missed packets
all ack'd
resend missed
send rqPackets - if missed
retry
too many retries
?
ack timeout
inc noACK
got ACK
Count complete

FIG. 13C

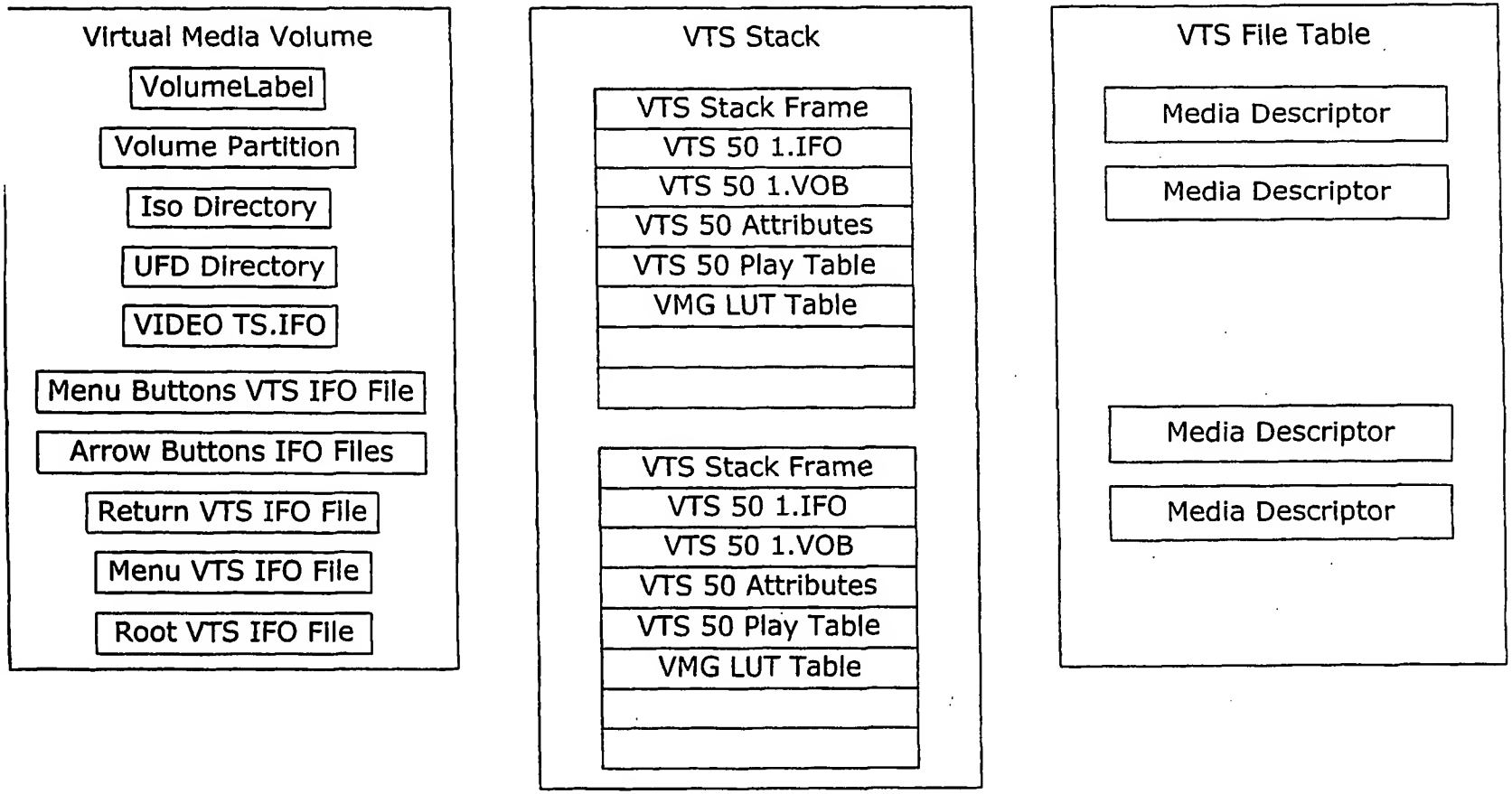
Virtual Media Volume
VolumeLabel
Volume Partition
Iso Directory
UFD Directory
VIDEO TS.IFO
Menu Buttons VTS IFO File
Arrow Buttons IFO Files
Return VTS IFO File
Menu VTS IFO File
Root VTS IFO File
VTS Stack
VTS Stack Frame
VTS 50 1.IFO
VTS 50 1.VOB
VTS 50 Attributes
VTS 50 Play Table
VMG LUT Table
VTS Stack Frame
VTS 50 1.IFO
VTS 50 1.VOB
VTS 50 Attributes
VTS 50 Play Table
VMG LUT Table
VTS File Table
Media Descriptor
Media Descriptor
Media Descriptor
Media Descriptor

FIG. 14A

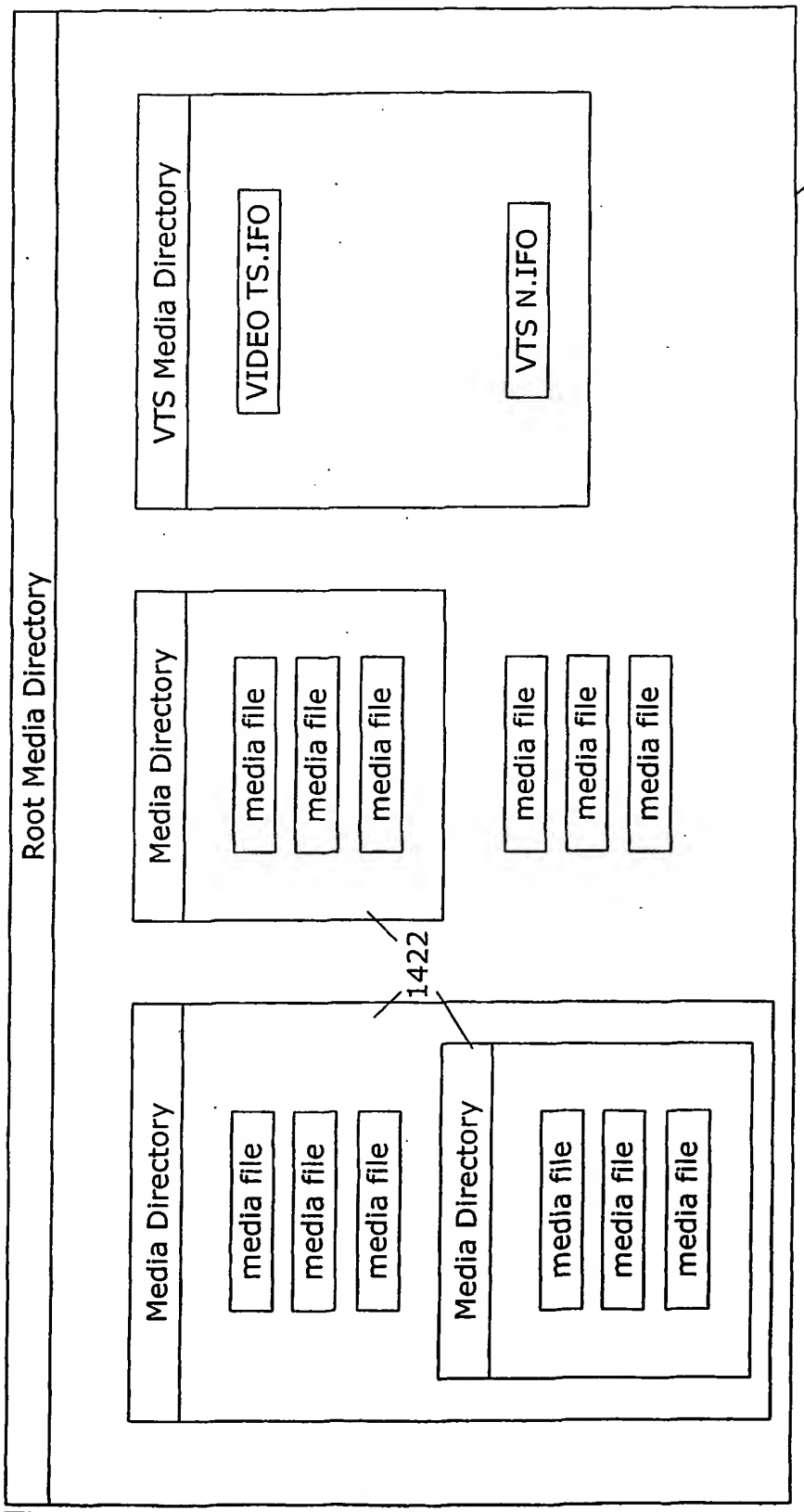
Root Media Directory
VTS Media Directory
VIDEO TS.IFO
VTS N.IFO
1420
Media Directory
media file
media file
media file
media file
media file
media file
1422
Media Directory
media file
media file
media file
Media Directory
media file
media file
media file

FIG. 14B

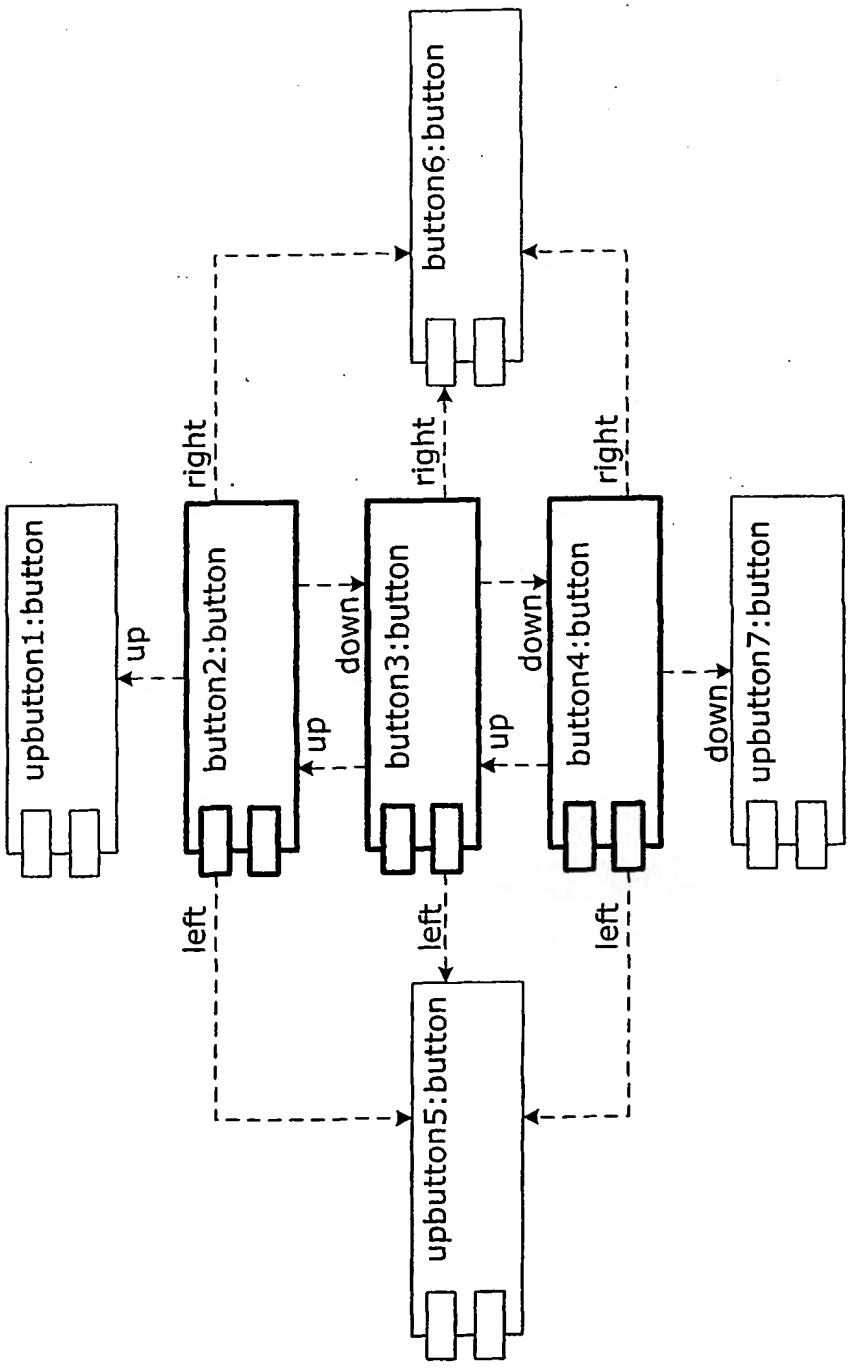
button6:button
right
right
right
upbutton1:button
up
button2:button
down
button3:button
down
button4:button
down
upbutton7:button
up
up
left
left
left
upbutton5:button

FIG. 14C

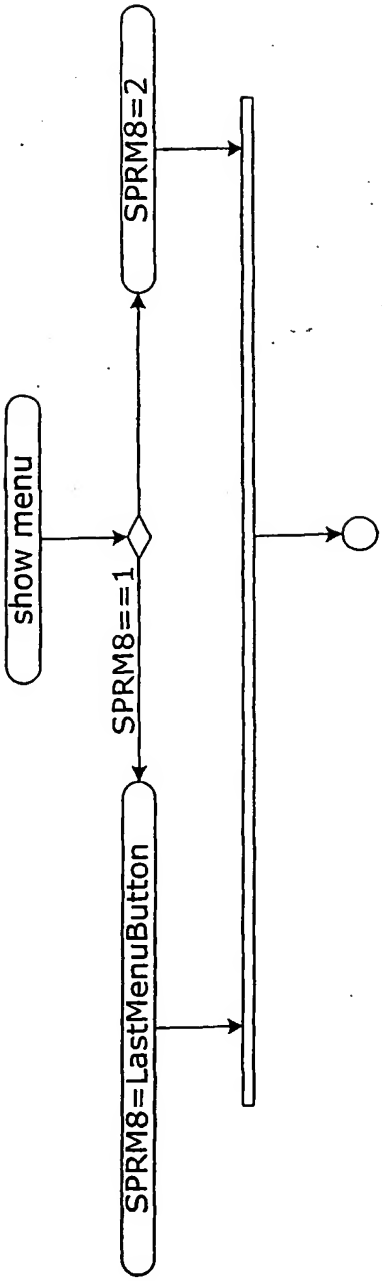

FIG. 14D

<<XSDschema>>
MaestroLink.xsd
{elementFormDefault, id-MaestroLink, targetNamespace}
<<XSDelement>>-photo{substitutionGroupString=slides}
<<XSDelement>>-music{substitutionGroupString=slides}
<<XSDcomplexType>>
<<XSDsequence>>
disc
{minOccurs=1, maxOccurs=1}
<<XSDanyAttribute>>-any
<<XSDelement>>-menu:menu[1..*]{sequenceOrder=1}
<<XSDattribute>>-specVersion{use}
<<XSDattribute>>-id{use}
<<XSDcomplexType>>
<<XSDsequence>>
menu
<<XSDanyAttribute>>-any
<<XSDelement>>-button:button[1..32]{sequenceOrder=1}
<<XSDattribute>>-id{use}
<<XSDattribute>>-title{use}
<<XSDattribute>>-bitmap{use}
<<XSDattribute>>-moving{use}
<<XSDcomplexType>>
slides
<<XSDanyAttribute>>-any
<<XSDattribute>>-id{use}
<<XSDcomplexType>>
video
<<XSDanyAttribute>>-any
<<XSDattribute>>-id{use}
<<XSDattribute>>-ifo{use}
<<XSDcomplexType>>
<<XSDchoice>>
button
{minOccurs1=0, maxOccurs1=1}
<<XSDanyAttribute>>-any
<<XSDattribute>>-id{use}
<<XSDattribute>>-autoButton
<<XSDattribute>>-destid
<<XSDattribute>>-bitmap{use}
<<XSDattribute>>-text
<<XSDattribute>>-left{use}
<<XSDattribute>>-top{use}
<<XSDattribute>>-right{use}
<<XSDattribute>>-bottom{use}
<<XSDattribute>>-nvidLeft{use}
<<XSDattribute>>-nvidRight{use}
<<XSDattribute>>-nvidUp{use}
<<XSDattribute>>-nvidDown{use}
<<XSDattribute>>-P{use}
<<XSDattribute>>-E1{use}
<<XSDattribute>>-E2{use}
<<XSDattribute>>-BG{use}
<<XSDattribute>>-E1c{use}
<<XSDattribute>>-E2c{use}
<<XSDattribute>>-BGc{use}
<<XSDattribute>>-Pc{use}
<<XSDelement>>-menu_ref{refString=menu}
<<XSDelement>>-video_ref{refString=video}
<<XSDelement>>-slides_ref{refString=slides}

FIG. 15

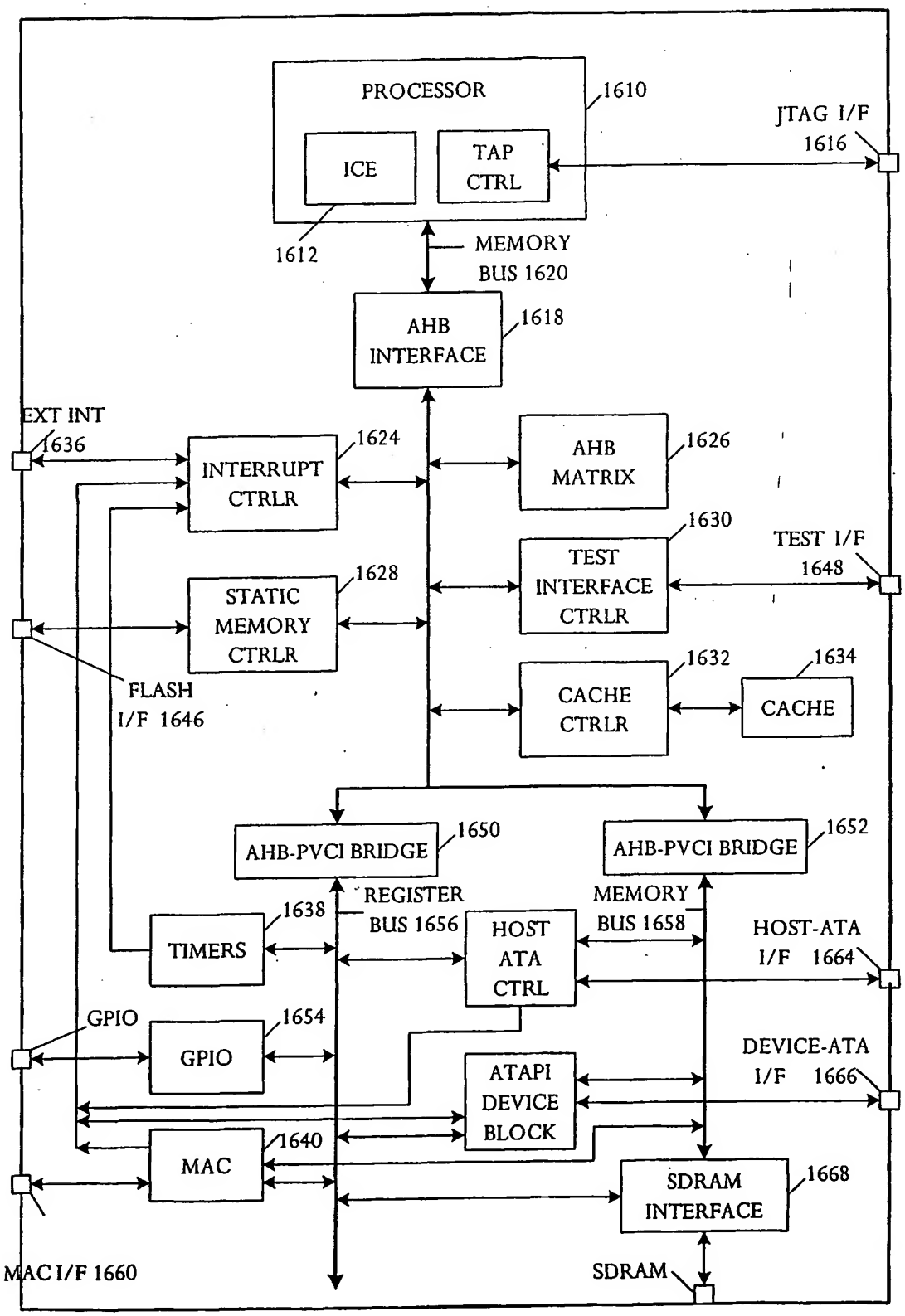
PROCESSOR
1610
ICE
TAP CTRL
JTAG I/F
1616
1612
MEMORY BUS 1620
AHB INTERFACE
1618
EXT INT
1636
INTERRUPT CTRLR
1624
AHB MATRIX
1626
1630
TEST INTERFACE CTRLR
TEST I/F
1648
1628
STATIC MEMORY CTRLR
FLASH I/F 1646
1632
CACHE CTRLR
1634
CACHE
AHB-PVCI BRIDGE
1650
AHB-PVCI BRIDGE
1652
REGISTER BUS 1656
MEMORY BUS 1658
1638
TIMERS
HOST ATA CTRL
HOST-ATA I/F 1664
GPIO
1654
GPIO
DEVICE-ATA I/F 1666
ATAPI DEVICE BLOCK
1640
MAC
SDRAM INTERFACE
1668
MAC I/F 1660
SDRAM

FIG. 16

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2005/022045

A. CLASSIFICATION OF SUBJECT MATTER
G06F17/30 H04L12/28 G11B27/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F H04L G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/073229 A (OAK TECHNOLOGY, INC) 4 September 2003 (2003-09-04) abstract; figures 1,3,5,9,13 page 5, line 23 - page 9, line 9 pages 13-14 pages 17-21 page 27, line 3 - page 32, line 16 page 35, lines 3-7 page 40, line 9 - page 41, line 15 page 45, line 17 - page 47, line 29 ----- -/--	1-7, 15-20

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 September 2005	08. 12. 2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Laurentowski, A

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2005/022045

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ANONYMOUS: "MaestroLink - Networked DVD Player Solution" ZORAN CORPORATION, [Online] 2003, pages 1-4, XP002346405 Sunnyvale, CA, USA Retrieved from the Internet: URL:http://web.archive.org/web/20040405082035/http://www.zoran.com/products/maestrolink/index.html> the whole document	1-7, 15-20
A	EP 0 911 728 A (SUN MICROSYSTEMS, INC) 28 April 1999 (1999-04-28) abstract paragraphs [0009], [0012] - [0014]	7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2005/022045

Box II Observations where certain claims were found unsearchable (Continuation of Item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-7, 15-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7, 15-20

Apparatuses and methods for handling media content, which appear to be characterised by the following features/steps, respectively:
a) an interface that couples to and acquires content from one or more sources including network-coupled sources and/or locally-coupled sources, the one or more sources supplying various content;
b) a user interface; and
c) a controller that dynamically configures a user interface that enables selection and access of the content, the dynamic configuring being user-transparent.
Multiple independent claims present in this group seem to describe various embodiments of the aforementioned alleged invention.
The problem to be solved by the subject matter of these claims seems to be how to enable a user to select and playback/view media content on a preferred device despite the fact that said content is physically stored on a different device and is thus playable under control of a different user interface or/and application.

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2. claims: 9-14, 50

Apparatuses and a method for handling media content, which appear to be characterised by the following features/steps, respectively:
a) a client device; and
b) a server that arranges content elements and navigation information in virtual media volumes forming a distributed file system and including a single title set,
c) the client device repeatedly playing the single title set as the server substitutes content from the single title set.
The problem to be solved by the subject matter of these claims seems to be how to organise arranging and rendering of media contents and graphical user interface elements on a DVD player (steered by a DVD menu), whereas said contents and said GUI elements are provided by a server networked with said DVD player.

---

3. claims: 8, 21-32, 51-61, 66-68

Apparatuses and methods for handling media content, which appear to be characterised by the following features/steps, respectively:
a)interfacing to a plurality of diverse sources supplying media content in multiple formats;
b)organizing the media content according to navigation information derived from relative location of the media and sources;
c)displaying the media content organization as a user interface for selecting a media content element for access; and
d)accessing a selected media content element.
Multiple independent claims present in this group seem to describe various embodiments of the aforementioned alleged invention.

The problem to be solved by the subject matter of these claims seems to be how to synthesise user interface information elements from different media source devices into a single common user interface (menu) to reflect the relative location of the media and sources.

---

4. claims: 33-49, 62-65

Apparatuses and methods for handling media content, which appear to be characterised by the following features/steps, respectively:
a)an interface between a plurality of content sources and at least one sink device; and
b)a controller coupled to the interface that:
-determines format or formats of content on the plurality of content sources and
-processes the format or formats to a format compatible with the at least one sink device without user interaction.
Multiple independent claims present in this group seem to describe various embodiments of the aforementioned alleged invention.

The problem to be solved by the subject matter of these claims seems to be how to automatically enable rendering media content encoded in one media format on a device supporting a different media format.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US2005/022045

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 03073229 A	04-09-2003	AU	2003213573 A1	09-09-2003
		AU	2003213574 A1	09-09-2003
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EP 0911728 A	28-04-1999	JP	11259304 A	24-09-1999
		US	2002007357 A1	17-01-2002
		US	6216152 B1	10-04-2001